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UNDERSTANDING METAPHORICAL USE OF VERBS

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## *Abstract*

How do people understand language in which verbs are used metaphorically? For example, how do people understand utterances such as He bathed in her beauty or She punctured his ego in everyday conversation? The general cognitive processes and discourse strategies described by the interactive-attributive model (Glucksberg & Keysar, 1990; Glucksberg, McGlone, & Manfredi, 1997) are investigated as a possible base for a cogent model of metaphorical verb use. Specifically, the use of the dual reference strategy of using the name of a category instance to name the category itself is investigated for verbs. Experiment 1 investigated factors that influence judgments of metaphoricity. Ratings of metaphors (e.g., The car flew across the intersection) suggest that verbs are interpreted metaphorically when their selection restrictions are violated. For example, the verb to fly normally (literally) takes subjects that are capable of air travel, such as birds or airplanes. When this restriction is violated (e.g., cars or ideas flying), the verb is judged as being used metaphorically. Furthermore, the degree of metaphoricity is a function of the degree of violation. Experiment 2 used a priming paradigm to test whether verbs can be used to make dual reference to either a literal action referent or to a generalized action category referent which it typifies. Different uses of verbs in either metaphorical (e.g., The idea flew) or literal (e.g., The bird flew) contexts, resulted in differential accessibility of action properties. For example, properties



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relevant to understanding the metaphor, such as flying is fast, are more accessible after metaphors than literal statements. Conversely, properties that are irrelevant to understanding the metaphor, such as flying is air travel, are less accessible after metaphors than literal controls.

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# Table of Contents

Abstract.....	iii
List of Tables.....	vii
List of Figures .....	ix
Acknowledgments.....	xi
 CHAPTER 1	 1
<i>Theoretical Background</i>	
Non-literal language as an anomaly: The multi-stage model.....	1
Two classes of metaphor models.....	4
The goal.....	5
The comparison approach: Metaphor as implicit simile.....	6
Similarity comparison.....	7
Metaphoric comparison.....	9
The comparison approach fails to explain metaphor.....	12
The attributive approach: Metaphor as class-inclusion assertions.....	15
 CHAPTER 2	 22
<i>Predicative Metaphors</i>	
Cues to metaphoricality of verbs.....	23
 CHAPTER 3	 27
<i>Experiment 1: Ratings of Predicative Metaphors</i>	
Method.....	27
Results and Discussion.....	34
Comprehensibility ratings.....	34
Metaphoricality judgments.....	45
Aptness ratings.....	55
Summary.....	62
 CHAPTER 4	 63
<i>Experiment 2: Dual reference in predicative metaphors</i>	
Method.....	66
Stimuli norming: Relevance of property statements.....	68
Priming paradigm.....	71
Results and Discussion.....	73

---

CHAPTER 5	76
<i>General discussion</i>	
REFERENCES.....	92
Appendix A: Stimuli.....	96
Appendix B: Values for relevant effects.....	113

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## *List of Tables*

<u>Table 1:</u> Examples of verb pairs reflecting the different informational value corresponding with Verb-type level.....	28
<u>Table 2:</u> Example of crossing of Verb-type by Noun-type giving the resulting pattern of selectional restriction violations (*indicates selectional restriction violation).....	29
<u>Table 3:</u> Examples of a six-sentence item set for both subject and object noun phrase item sets (*indicates selectional restriction violation).....	30
<u>Table 4:</u> Mean comprehensibility rating by condition type (*indicates selectional restriction violation).....	35
<u>Table 5:</u> Mean metaphoricity rating by condition type (*indicates selectional restriction violation).....	46
<u>Table 6:</u> Mean aptness rating by condition type (*indicates selectional restriction violation).....	56
<u>Table 7:</u> Examples of items for priming paradigm in Experiment 2.....	68

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## *List of Figures*

<u>Figure 1</u> : Mean comprehensibility rating by sentence type (*indicates selectional restriction violation).....	37
<u>Figure 2</u> : Mean comprehensibility rating as a function of Noun-type for subject noun phrase sentences with specific verbs, e.g., “fly” (*indicates selectional restriction violation).....	39
<u>Figure 3</u> : Mean comprehensibility rating as a function of Noun-type for object noun phrase sentences with specific verbs, e.g., “uncork” (*indicates selectional restriction violation). ....	39
<u>Figure 4</u> : Mean comprehensibility rating as a function of Noun-type for subject noun phrase sentences with general verbs, e.g., “travel” (*indicates selectional restriction violation). ....	40
<u>Figure 5</u> : Mean comprehensibility rating as a function of Noun-type for object noun phrase sentences with general verbs, e.g., “open” (*indicates selectional restriction violation). ....	40
<u>Figure 6</u> : Mean comprehensibility rating as a function of Verb-type by Noun-phrase for sentences with nouns that do not violate either verb, e.g., “bird/bottle” .....	43
<u>Figure 7</u> : Mean comprehensibility rating as a function of Verb-type by Noun-phrase for sentences with nouns that violate the specific verb, e.g., “boy/gate” (*indicates selectional restriction violation). ....	43
<u>Figure 8</u> : Mean comprehensibility rating as a function of Verb-type by Noun-phrase for sentences with nouns that both verbs, e.g., “idea/thoughts” (*indicates selectional restriction violation). ....	44
<u>Figure 9</u> : Mean metaphoricity rating as a function of sentence type (*indicates selectional restriction violation). ....	48
<u>Figure 10</u> : Mean metaphoricity judgments as a function of Noun-type for subject noun phrase sentences with specific verbs, e.g., “fly” (*indicates selectional restriction violation). ....	50

---

<u>Figure 11</u> : Mean metaphoricity judgments as a function of Noun-type for object noun phrase sentences with specific verbs, e.g., “uncork” (*indicates selectional restriction violation). .....	50
<u>Figure 12</u> : Mean metaphoricity judgments as a function of Noun-type for subject noun phrase sentences with general verbs, e.g., “travel” (*indicates selectional restriction violation). .....	51
<u>Figure 13</u> : Mean metaphoricity judgments as a function of Noun-type for object noun phrase sentences with general verbs, e.g., “open” (*indicates selectional restriction violation). .....	51
<u>Figure 14</u> : Mean metaphoricity judgments as a function of Verb-type by Noun-phrase for sentences with nouns that do not violate either verb, e.g., “bird/bottle” (*indicates selectional restriction violation). .....	52
<u>Figure 15</u> : Mean metaphoricity judgments as a function of Verb-type by Noun-phrase for sentences with nouns that violate the specific verb, e.g., “boy/gate” (*indicates selectional restriction violation). .....	53
<u>Figure 16</u> : Mean metaphoricity judgments as a function of Verb-type by Noun-phrase for sentences with nouns that violate both verbs, e.g., “idea/thoughts” (*indicates selectional restriction violation). .....	53
<u>Figure 17</u> : Mean aptness rating by sentence type (*indicates selectional restriction violation). .....	58
<u>Figure 18</u> : Mean aptness rating as a function of Noun-type for subject noun phrase sentences with specific verbs, e.g., “fly” (*indicates selectional restriction violation). .....	60
<u>Figure 19</u> : Mean aptness rating as a function of Noun-type for object noun phrase sentences with specific verbs, e.g., “uncork” (*indicates selectional restriction violation). .....	60
<u>Figure 20</u> : Mean aptness rating as a function of Noun-type for subject noun phrase sentences with general verbs, e.g., “travel” (*indicates selectional restriction violation). .....	61
<u>Figure 21</u> : Mean aptness rating as a function of Noun-type for object noun phrase sentences with general verbs, e.g., “uncork” (*indicates selectional restriction violation). .....	61

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Figure 22: Mean rating of relevance of property statements as a function of Prime type (literal vs. metaphor) and Target type (relevant vs. irrelevant to the ground of the metaphor). .....70

Figure 23: Mean response time (msec) in priming paradigm for the “makes sense” judgment as a function of Prime type (literal vs. metaphor) and Target type (relevant vs. irrelevant to the ground of the metaphor).....74

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# *Chapter 1*

## *Theoretical Background*

Figurative language seems to pose a difficult problem: why don't people do a double take when they encounter metaphors or idioms? Why don't they stop dead in their comprehension tracks? After all, it seems natural for people to hesitate when someone asserts that which is flatly false and could not be possible. For example, the statement My job is a jail, or Mrs. Woods is the neighborhood watchdog, clearly violates category membership constraints. Jobs cannot be jails and people are not dogs. Similarly, the statement I hope that my ideas fly at the conference, oddly implies that ideas are entities that can travel through the air. It also seems counter-intuitive that friends could wish me "good luck" by telling me to break a leg or offer encouragement by telling me not to worry because I will nail my points down and end up knocking 'em dead.

### Non-literal language as an anomaly: The multi-stage model

Traditional theories of figurative language processing proposed that people did a double take when understanding non-literal language. Figurative language was treated as an anomaly of language processing, and as such, processed differently than literal language (Grice, 1975; Searle, 1979). Specifically, this traditional view argued that figurative interpretations are reached only after the default literal processes fail. The classic multi-stage model claims that non-literal

utterances, such as metaphors, idioms, and indirect requests, are first processed for a literal meaning. Further processing occurs if, and only if, the literal interpretation conflicts with its context. Psychological consequences of this model, therefore, include a) that literal interpretations are always derived, and done so first, b) a non-literal understanding is reached only if a literal interpretation is not possible, and c) non-literal interpretations require more processing than literal ones (Grice, 1975; Searle, 1979). This traditional multi-stage model suggests, therefore, that although people may not stop in their metaphor comprehension tracks - they, at least initially, head in the wrong direction.

Enough evidence has accumulated to reject the multi-stage model's claims a) for the priority of the literal and b) that figurative interpretations always require additional processing. Literal interpretations are not always dominant when understanding idioms or indirect requests (Bobrow & Bell, 1973; Gibbs, 1984). For example, Bobrow and Bell (1973) asked participants to report "first-perceived meaning" of phrases such as John gave Mary the slip. These phrases are ambiguous because they can be interpreted in either a literal or a figurative sense. When preceded by an idiomatic context (i.e., four non-ambiguous idiomatic expressions), participants reported first perceiving an idiomatic meaning of the ambiguous target phrase. Since non-literal meanings were the primary understanding of phrases that had plausible literal interpretations, the literal meaning is not always dominant. Glucksberg, Gildea, and Bookin (1982) offer

evidence against the claim that non-literal interpretations must be triggered by a defective interpretation in context. They found that participants could not ignore figurative meanings when making speeded judgments of the literal truth of sentences. For example, it took longer to reject literally false but true metaphors, such as Some jobs are jails, than to reject literal false sentences. The availability of a plausible metaphorical interpretation interfered with participants' literally-false judgments. Finally, figurative language is often understood as quickly, if not more quickly than its literal counterpart (Gibbs, 1980; Ortony, Schallert, Reynolds, & Antos, 1978; Swinney & Cutler, 1979). This suggests that figurative language does not always require additional processing.

Upon further reflection it becomes apparent that the problem posed by figurative language is a problem for language use in general. There has been a shift from treating figurative and literal language processing as being governed by distinct mechanisms to a view of figurative language as a special case of ambiguity that is typical of all language use (Cacciari & Glucksberg, 1991; Gibbs, 1980; Glucksberg, 1993; Glucksberg et al., 1982; Keysar & Glucksberg, 1992; Ortony et al., 1978; Swinney & Cutler, 1979). Figurative language simply highlights, or foregrounds, a central problem for language processing theories: the ubiquitous ambiguity in language.

Acknowledging that figurative language is not fundamentally different, in kind, from literal language processing is an important first step. This shift emphasizes that figurative language use involves general cognitive and linguistic

processes. However, it does not provide a complete answer. There still seems to be a difference between figurative and literal language - after all, we recognize it as such. How is figurative language, specifically metaphor, understood?

### Two classes of metaphor models

Most theories of metaphor use and comprehension are based on research that focuses on a particular type of metaphor: nominal metaphors of the form "X is a Y". In these cases, nouns are used metaphorically, e.g., Sarcasm is a weapon. Within the contemporary framework that views figurative language as using the same processing mechanisms as literal language, theories of metaphor use and comprehension fall into two general classes. The comparison view (Gentner, 1983; Miller, 1993; Ortony, 1979; 1993) treats metaphors as implicit similes (i.e., "X is like a Y"). Property matching models (Gentner, 1983; Ortony, 1979; Wolff & Gentner, 1992), for example, claim that the ground of the metaphor, or its interpretation, is discovered by matching properties of the topic (i.e., the X term) and the vehicle (i.e., the Y term). In contrast, the interactive-attributive view (Glucksberg & Keysar, 1990; 1993) claims that metaphors are exactly as they seem to be: class-inclusion assertions. They claim that jobs actually can be jails and that people really can be watchdogs. This view claims that the ground of the metaphor is not discovered by property matching, but instead by discourse strategies and cognitive processes that attribute properties of the vehicle to the topic.

Neither of these views, however, has empirically addressed how people understand verbs that are used metaphorically. For example, how do people understand statements such as He bathed in her beauty or She punctured his ego in everyday conversation? It is not clear how a property matching view would account for predicative metaphors such as these. Property matching between bathing and beauty does not seem to lead to a likely interpretation (although see Miller, 1993). On the other hand, the interactive-attributive view describes some general mechanisms that may play a role in the use and comprehension of conversational predicative metaphors.

#### The goal

The aim of this work is to investigate the metaphorical use of verbs, thereby expanding the present scope of theories and research on metaphor use and comprehension. This initial investigation focuses on two broad questions that are important for metaphor comprehension in general: a) how is non-literal language, specifically metaphor, comprehended?, and b) how do we recognize when a figurative meaning is intended?

The goal of this thesis is to assess which class of models accounts for predicative metaphor processing. It will be argued that the interactive-attributive view (Glucksberg & Keysar, 1990; 1993; Glucksberg, McGlone, & Manfredi, 1997; Manfredi & Glucksberg, 1994) is the preferred starting point for a cogent model of predicative metaphor processing for the same reasons that it is preferred

to account for nominal metaphor comprehension. Specifically, the questions addressed are: a) how are predicative metaphors, such as She devoured the lecture material or His betrayal poisoned their friendship, understood? b) what cues indicate their metaphorical nature?

The traditional comparison view of nominal metaphor processing will first be described and its explanatory effectiveness contrasted with the interactive-attributive view. The strengths of the interactive-attributive view will be outlined in terms of what aspects of it may, or may not, be applicable to predicative metaphors. In addition, the relevant possible differences between nouns and verbs that may influence processing will be discussed. Finally, two experiments will be presented that provide initial evidence on what factors create a sense of verbs being used metaphorically and how predicative metaphors are understood.<sup>1</sup>

The comparison approach: Metaphor as implicit simile

Traditionally, models of metaphor comprehension have treated statements of the form "A is a B" as implicit similes (e.g., "A is like a B") (Miller, 1993; Ortony, 1979; Searle, 1979). According to this view, once the implicit simile is recognized, metaphors can be treated as any other similarity comparison. The problem with similarity, of course, is that everything is similar to everything else

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<sup>1</sup>The scope of the studies will be limited to the domain of conversational metaphors, since literary or poetic metaphor may well involve different and more complex processes.

in some way or another. The difficulty is in specifying in what respects things are similar (Goodman, 1972; Medin, Goldstone, & Gentner, 1991).

Similarity comparison.

Tversky's (1977) contrast model attempts to account for two important issues of similarity judgments: a) similarity judgments are asymmetric, and b) similarity judgments are context-dependent.

In this model, similarity is determined in two stages. The first stage extracts the relevant features of each item in the comparison. The second stage involves matching the extracted features of both items. Since the relevant features are determined before the matching process, the contrast model is a selective comparison model. The model does not specify how the relevant features are initially selected, but it does specify their relative role in the matching process. The salience of the selected features determines their weighted values, and thus their impact on the matching stage. The greater the salience of a feature, the more it will be weighted, resulting in a greater impact on the contrasting process and perceived similarity. The resulting perceived similarity increases as a function of shared features between the two items and decreases as a function of non-shared features between the compared items. The differential salience weighting of features accounts for the two major phenomena of similarity judgments previously mentioned. With respect to the asymmetry of similarity judgments, Tversky argues:

In such a task one naturally focuses on the subject of the comparison. Hence, the features of the subject are weighted more heavily than the features of the referent. ...the direction of asymmetry is determined by the relative salience of the stimuli so that the less salient stimulus is more similar to the salient stimulus than vice versa (Tversky, 1977, p. 333).

Thus, if the United States is more salient than Mexico, then the statement Mexico is similar to the United States should be preferred over the statement The United States is similar to Mexico. Indeed, Tversky reports evidence for this salience driven asymmetry in both preference tasks and ratings of similarity for countries and for abstract figures. The contrast model, therefore, accounts for directional influences on comparisons by giving more weight to salient features in the matching process.

Judgments of similarity can be affected by the set of objects under consideration. Participants' choice of similarity to a particular target can be affected by changing the selection set. For example, Austria was considered more similar to Sweden when choosing from the set of Sweden, Poland, and Hungary. However, Austria was judged as more similar to Hungary when the set was changed, replacing Poland with Norway. Set effects were also reported with visual stimuli (e.g., simple face drawings). The contrast model accounts for context effects in terms of salience; changing the set of objects under consideration results in different features becoming salient. For example, Cuba is similar to Jamaica as well as to Russia, but they are similar with respects to different things (i.e., geography and politics, respectively).



The contrast model, therefore, accounts for two major phenomena related to similarity comparisons: asymmetric relations and the effect of context. However, it should be noted that the contrast model describes both order and context effects in terms of feature salience, not feature selection. This can be problematic because the grounds of a similarity assertion can change as a result of order or context. As will be discussed, relevant feature selection is also important in metaphoric comparisons.

#### Metaphoric comparison.

In treating metaphors as similarity comparisons, the question arises: what distinguishes metaphorical comparisons from literal ones? Ortony (1979) elaborated Tversky's (1977) contrast model to directly address metaphorical comparisons. In particular, Ortony addressed two characteristics of metaphor which the contrast model fails to explain: a) how are people able to judge metaphoricity?, and b) why are metaphoric comparisons essentially non-reversible?

In the contrast model (Tversky, 1977), the selected features of the A and B terms are independently weighted according to their salience. However, Ortony argues that salience of a property is not independent, but rather, dependent upon the particular object of which it is a part. Therefore, a property (e.g., being tall) can be more important for one object (e.g., a basketball player) than for another (e.g., a tennis player). As a result,

The salience of the intersection of A and B is dependent on the salience values of matching elements in B, rather than on some function of the values in both A and B or of their values in A alone (Ortony, 1979, p. 164).

This differs from the contrast model which, in stage one, determines relevant features and then, in stage two, searches for matches. Instead, the search for matches occurs without pre-selection of relevant features. Thus, after matching elements are found, salience of the properties of each object are assessed relative to one another. Since the relevant features are determined after rather than before the matching process, this model is an exhaustive comparison model. Ortony claims that salience imbalance is the indicator of metaphoricity, as well as the explanation for why metaphors are irreversible.

In a literal similarity statement involving very similar objects (e.g., lemons are like limes), the matching properties of the A (lemons) and B (limes) terms are salient for both terms (high A/high B). In a literal statement where the two objects are not very similar (as olives are like cherries, in that they both have pits), the matching properties are not very salient for either term (low A/low B). Indeed, such statements may be considered trivial or anomalous according to Grice's (1975) cooperative principle, specifically the maxim to be informative. Metaphoric comparisons, on the other hand, involve comparisons between two unlike things which share no salient features. The degree of metaphoricity is determined by the extent of the asymmetry in salience of the matching properties (low A/high B). In metaphors, the salience (or weight) of the matching features is

dependent upon the B term. For example, in the metaphor My job is a jail, the salient features of jail (which are not salient for my job) act as the ground for the metaphor (e.g., things that are unpleasant, confining, unrewarding, etc.). The greater the imbalance between the salience of attributes for B and A, the greater the judged degree of metaphoricity.

Salience imbalance, which acts as a cue to metaphoricity, also seems to be the key to the irreversibility of metaphors. A reversed metaphor results in the matching attributes being highly salient of the subject and of lower salience of the predicate (high A/low B). If the attribute is salient of the topic and not the predicate, then the statement violates the given-new relationship and Grice's conversational maxims (Clark & Haviland, 1977; Grice, 1975). In this case, the statement is uninformative and considered to be anomalous (e.g., My jail is a job).

In sum, Ortony's (1979) salience imbalance model builds on the contrast model to account for the metaphoricity and irreversibility of metaphorical comparisons. The relative salience of the matching attributes of the comparison terms indicates the type of comparison statement that would be perceived. Statements with equal levels of salience for each term are perceived as literal similarity comparison statements (high A/high B or low A/low B) with varying degrees of similarity determined by the degree of salience of the matching attributes. Statements that have a salience imbalance between the two compared terms are perceived either as metaphoric comparisons (e.g., in the form low A/high B) or as anomalous, uninformative statements (e.g., high A/low B).

The comparison approach fails to explain metaphor

Ortony's (1979) salience imbalance model is typical of the traditional class of models of metaphor comprehension that Glucksberg and colleagues have referred to as matching models (Glucksberg, 1991; Glucksberg & Keysar, 1990, 1993; Glucksberg, et al., 1997; for matching models see also Gentner, 1983; Ortony, 1979, 1993; Wolff & Gentner, 1992). In general, matching models extract all features of the comparison terms and then exhaustively check for matches between attributes of the two terms. Once matching attributes are determined, the salient and informative matches are used as the ground for the comparison. As previously described, Ortony argues that salience imbalance is the key indicator as to which matching properties are understood as the ground of the metaphor. Gentner argues that matches that are based on relations between objects within each term, rather than attributes of objects, will be preferred as the mapping choice between two terms of a comparison.

Glucksberg and Keysar (1990) argue that Ortony's (1979) salience imbalance model, and similarity comparison models in general, are inadequate descriptions of metaphor comprehension. By assuming that metaphors rely upon comparison processes, they fail to describe two important characteristics of metaphors: a) the non-reversibility of metaphorical comparisons, and b) the selection of features.

According to the salience imbalance model, when a metaphor is reversed, My jail is a job, the attributes of the subject are highly salient and those of the

predicate have low salience (high A/low B). Recall that this imbalance violates the given-new relationship and so it is considered uninformative and anomalous. Glucksberg and Keysar point out that this argument also applies to literal comparison statements. If attributes are highly salient for both terms (high A/high B), as the salience imbalance model claims, then it should also be considered anomalous because it also violates the given-new relationship. Salience imbalance does not, therefore, supply an account for irreversibility of metaphors. In addition,

... salience imbalance cannot distinguish between literal and metaphorical comparisons because such imbalance characterizes all informative comparisons (Glucksberg & Keysar, 1990, p.6).

They also illuminate a fundamental problem that faces the salience imbalance model and other matching models. These models assume that, first, matches of attributes are determined between topic and vehicle. Once matches are found, then their relevance is determined and salience assigned. In many circumstances, however, a metaphoric comparison involves attributes that are not a part of the representation of the topic. For example, comprehension of the statements George is a pig or My job is a jail would require that there is some attribute in the listener or reader's representation of George and my job that match the attributes of their respective vehicles. Clearly, this is not the case if the listener does not know the person George, nor what my job entails. Indeed, cases in which the listener does have a representation of the topic of comparison (e.g., George or my job) again beg the question of whether the statement is being

informative: it is not informative if the specific attribute suggested in the comparison is already represented in the listener's representation of the topic (Glucksberg & Keysar, 1990; Clark & Haviland, 1977; Grice, 1975).

From these two points, it follows that any informative comparison, be it literal or metaphorical, cannot be based on matching properties. The ground of any informative comparison cannot be determined by selecting features from those that match between subject and predicate. Instead, both require a comparison to be determined by highly salient features of the predicate which can be relevant to the subject. For example, if someone knows what lemons are, but not limes, then the statement limes are like lemons is informative. It seems that in both cases, properties of the predicate are attributed to the subject.

Matching models, then, may serve as models of comparison-statement *assessment* or *verification*. They cannot serve as the basis for models of comprehension of such statements, be they literal or metaphorical (Glucksberg & Keysar, 1990, p.7).

In short, based on discourse principles, matching models are insufficient accounts of the comprehension of any comparison statement. Thus, any model that relies on matching properties cannot account for metaphor comprehension.

The two basic questions for metaphor comprehension remain open: What distinguishes metaphoric from literal comparisons? And how is the ground of the comparison determined? In contrast to the traditional assumption that metaphors are understood as implicit similes, Glucksberg and Keysar (1990) "suggest the opposite: that similes (i.e., metaphoric comparisons) are to be understood as

implicit metaphors" (p. 7). Thus, metaphorical comparisons are not similarity-based, but rather class-inclusion assertions. They argue that this is the source of the distinction between metaphoric and literal comparisons, as well as the key to how metaphors are comprehended.

The attributive approach: Metaphors as class-inclusion assertions

The view of metaphors as class-inclusion assertions shifts the locus of comprehension from property matching to property attribution (Glucksberg & Keysar, 1990). This view claims that nominal metaphors are exactly as they appear to be: class-inclusion assertions. Rather than property matching, nominal metaphors are understood as a result of properties of Y, the vehicle term, being attributed to X, the topic. This attribution of properties from the vehicle to the topic accounts for a fundamental problem facing the matching models. Specifically, it accounts for the comprehension of statements like George is a pig and My job is a jail which may refer to people or things (i.e., George or my job) for which the listener has no prior representation. The questions remain: How are the properties that are to be attributed to the topic selected? And what distinguishes metaphoric and literal class-inclusion assertions?

According to the interactive-attributive view (Glucksberg & Keysar, 1990; 1993; Manfredi & Glucksberg, 1994; Glucksberg, et al., 1997), the properties of Y which are attributed to X are initially identified and selected in the same way similarity assertions in general are treated. For example, how are oranges and lemons alike? They are both fruit. Oranges and lamb chops? Both are foods

(Weschler, 1958). Thus, one way that literal similarity between two concepts can be initially described is in terms of membership in a common category. Metaphoric comparisons can be viewed in the same way. The topic and vehicle jointly define a common category to which they both belong.

In general, items can be cross-classified in any number of ways. For example, a jail can be a member of the category of punishments (including spankings, traffic tickets, etc.), multi-occupant facilities (including hospitals, hotels, etc.), or human-made structures (including igloos, skyscrapers, etc.). A jail can also be a member of a category that does not have a conventional name. For example, it can be a member of the class of situations that are confining, unpleasant, unrewarding, involuntary, etc. In addition, jail is a prototypical member of such a category. As such, it can be used to name this otherwise unlexicalized category. Other members of the category of situations that are unpleasant, confining and unrewarding can include such things as my job or my relationship (Glucksberg & Keysar, 1990). For example, My job is like a jail places my job and jail into a non-lexicalized attributive category of situations that are confining, difficult to get out of, unpleasant, unrewarding, etc. It is joint membership in this non-lexicalized, attributive category that identifies the ground of the metaphor. How are categories, such as these, named?

A crucial difference between literal and metaphoric categorization suggests an answer. Metaphorical class-inclusion assertions can be transformed into a comparison statement without significantly altering its meaning, but the



same is not the case for literal classification. For example, the metaphor My job is a jail can be expressed as My job is like a jail, and vice versa. However, literal category assertions and comparison statements do not exhibit this flexibility of form. For example, limes are fruit cannot be stated in the comparison construction as \*limes are like fruits. Nor can the comparison limes are like lemons be restated as a class-inclusion assertion, \*limes are lemons. The fact that the format (i.e., class-inclusion or comparison) can be switched for metaphorical but not literal comparisons suggests that the predicate is being used differently in each case: in metaphors the predicate (i.e. the vehicle) can be used to name the attributive category (Brown, 1958; Glucksberg & Keysar, 1990; Glucksberg, et al., 1997). The vehicle term jail can be used to name the superordinate category to which the literal jail and the topic both belong. In an apt metaphor, the vehicle term is a prototypical member of the non-lexicalized superordinate category and, thus, serves as a good name for the category. Therefore, metaphor vehicles are used and understood as making dual reference: to the mental representation of the literal referent (e.g., actual jails), and/or to the mental representation of the category of things or situations that the metaphor vehicle exemplifies (e.g., situations that are confining, oppressive, imposed, etc.).

Dual reference is not specific to metaphor, but rather is a general discourse strategy for naming superordinate categories which do not have a name of their own. In dual reference, the name of a prototypical category exemplar serves as the name for the category itself. For example, we refer to generic product

categories by particular brand names: "kleenex" for facial tissues, "xerox" for photocopying, "jello" for gelatin, "q-tips" for cotton swabs, and "rollerblades" for in-line skates.

When dual reference is employed, expressions can be framed either as comparison statements or as class-inclusion assertions. For example, Her new car is like a jeep and Her new car is a jeep are generally interchangeable. Therefore, one criteria test for dual reference is the ability to paraphrase a class-inclusion assertion (i.e., is a form) as a comparison statement (i.e., is like a form), and vice versa (Glucksberg & Keysar, 1990). The fact that metaphors can be paraphrased this way suggests that metaphor vehicles are used to make dual reference - to the literal category instance and/or to the non-lexicalized attributive category that it exemplifies.

Although both the topic and vehicle of a metaphor jointly determine their category membership, each play different but interacting roles in determining the ground, or interpretation of the metaphor (Glucksberg, et al., 1997). Metaphor topics constrain the dimensions of attribution which would be relevant to the metaphor. For example, there are a number of relevant dimensions of attributes for the topic surgeons. One may expect to be informed about a surgeon's expertise, cost, or availability, but not about his or her eye color or spouse's hobbies. Metaphor vehicles, in turn, provide property values along relevant dimensions that are to be attributed to the topics.

Because the topics and vehicles play different roles, they provide different kinds of information to constrain and guide the comprehension process. As a result one can get different interpretations for metaphors with identical topics or identical vehicles. For example, dimensions of attributes of a job may include salary or degree of freedom, but the values of those attributes are not specified. Thus, the interpretations of My job is a jail (i.e., unrewarding, unpleasant, etc.) and My job is a goldmine (i.e., lucrative, rewarding, etc.) are constrained by the relevant dimensions of my job (e.g., salary, room for advancement, fulfillment, etc.). However, the different vehicles provide different property values, generally positive or negative, to be attributed to my job. Thus the topic, my job, provides constraints on what dimensions of attributes are relevant to it and the vehicles, jail or goldmine, provide values for those relevant dimensions. Similarly, metaphors with the same vehicle can result in different interpretations. The vehicle goldmine provides the value of lucrative, rewarding, etc. for the topic my job, but provides a different value for other topics. The topic libraries suggests different attribute dimensions, such as quality and quantity of information. As such, goldmine provides the value of a rich or plentiful information source in Libraries are goldmines. Therefore, in metaphorical groupings the interacting roles of the topic and vehicle terms determine the ground of the metaphor through the mechanisms of classification and dual reference.

It follows from the interactive-attributive view that metaphors are non-reversible. Metaphors are non-reversible because class-inclusion assertions are

not reversible. Reversing a class-inclusion assertion usually results in an anomalous statement (e.g., My jail is a job). In special cases in which both terms are prototypical members of different categories that happen to be applicable to one another, metaphors can make sense when reversed. In these cases, however, reversing the statement changes the ground of the metaphor because the vehicle names the superordinate functional category from which property values are selected. Reversing a statement changes the vehicle term which, therefore, alters the ground of the metaphor. For example, in My surgeon was a butcher the properties being attributed refer to incompetence (e.g., an unskillful or careless workman). In the reverse, My butcher is a surgeon, the properties being attributed refer to a highly skilled workman who is meticulous and detailed (Glucksberg & Keysar, 1990; see also Glucksberg, 1991; Glucksberg et al., 1997; Keysar & Glucksberg, 1992). In contrast, there can be a preferred directionality for literal statements (Tversky, 1977), but the ground of comparison is rarely altered by reversing it (e.g., compare platinum is like gold vs. gold is like platinum). Indeed, results from one study (Glucksberg et al., 1997) in which subjects were asked to rate the meaningfulness of reversed metaphors, metaphoric comparisons, and literal comparisons indicates that literal comparisons are reversible, while metaphors or metaphorical comparisons are not. The class-inclusion view can thus account for the metaphor phenomena that matching models fail to explain. As discussed above, it can distinguish between literal and metaphorical comparison statements, account for how features are selected, and account for the

non-reversibility of metaphorical statements. Glucksberg and Keysar (1990) conclude that "Understanding similarity is not central to understanding metaphor: The central problem is to understand categorization" (p.17).

In sum, the interactive-attributive model (Manfredi & Glucksberg, 1994; Glucksberg et al., 1997) makes two distinct claims. First, the vehicle is used to make dual reference. This means the vehicle, or Y term, can be understood at two levels of abstraction: the literal referent and/or the more general attributive category. Second, the metaphor vehicle and topic play different but interacting roles. The topic, or X term, provides constraints on what is likely to be attributed to it (i.e., it provides the relevant dimensions for attribution) and the vehicle, or Y term, provides properties to be attributed to the topic. Can the interactive-attributive view be extended to predicative metaphor comprehension?

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## Chapter 2

### *Predicative metaphors*

There may be important differences between nouns and verbs. For instance, there are fewer English verbs than nouns, yet verbs are more polysemous (Miller et al., 1993). Miller et al. (1993) report that the Collins English Dictionary lists over 43,000 different nouns, but only 14,000 verbs; the nouns average 1.74 senses and the verbs average 2.11 senses. In addition, Gentner (1981) reports that common verbs have greater breadth of meaning than common nouns. The twenty most frequent nouns (mean word frequency 663.7) have an average of 7.3 word senses each, while the twenty most frequent verbs (mean word frequency 1745.0) have an average of 12.4 word senses each. Because verbs have so many senses, they may be used much more flexibly than nouns. As a result, people may not even judge that a verb is used metaphorically when it is extended in minimal ways. For example, the surface category violation in the nominal metaphor She is an open book makes it fairly clear that it is intended figuratively. However, some people may judge the use of flew in The boy grabbed his bike and flew down the hill, to simply be another sense of to fly, rather than a figurative use of it. Thus, identifying a metaphorical use of a verb may not be as straight-forward as identifying nouns used metaphorically.

Cues to metaphoricity of verbs

The selectional restrictions of a verb may be a candidate indicator of the surface violation in predicative metaphors. Selectional restrictions of verbs constrain the noun phrases that can occur with them. For example, knowing that X ate the leftovers suggests that X is an animate subject, such as a person (John or Mary), a pet dog (Spot or Fifi), or a raccoon (Ranger Rick); X is something capable of eating. The selection restriction of verbs are contained in the verb's lexical entry.

There are two general approaches to describing the semantic information that is part of a verb's lexical entry, or in describing semantic information in general. The first is a compositional view in which meanings of words can be broken down into simpler components, or atoms of meaning (Johnson-Laird & Quinn, 1976; Miller & Johnson-Laird, 1976). A classic example is that kill can be decomposed into its parts to reach the meaning to cause to become not alive: cause and die --> not alive are primary components of the more complex word kill. The compositional framework of semantics therefore relies on the notion of semantic primitives, a finite set of universal semantic-conceptual components. As such, according to this view verbs can vary along a dimension of complexity (Johnson-Laird & Quinn, 1976; Miller & Johnson-Laird, 1976; Miller et al., 1993).

The second approach describes semantic information and organization in terms of semantic relations. In a relational semantic analysis, the lexical item is

taken as the smallest unit of analysis, rather than hypothesized atoms of meaning (Fellbaum & Miller, 1990; Miller et al., 1993). Thus, the semantic information of verbs can come from the semantic relations linking verbs to each other. For example, an oak is a type of tree which, in turn, is a type of plant. This subordinate - superordinate (hyponymy / hypernymy) is a relation is a core organizing relation for nouns. Some researchers (Collier & Fellbaum, 1988; Fellbaum & Miller, 1990), however, have suggested that nouns and verbs differ in their fundamental organization in semantic memory. A hierarchy of nouns tends to involve more levels and be structured by the is a relation. Verbs, by contrast, are better described by a troponymic, or manner of relation. For example, to stroll is to walk in some manner, and to walk is to travel in some manner. Verbs also tend to have fewer levels in their hierarchy structure than nouns, with a proliferation of verbs at one level of the tree (Fellbaum & Miller, 1990; Miller et al., 1993).

Although these two approaches are fundamentally at odds, within any particular domain, or semantic field, a semantic structure ranging from the more general to the more specific can be discerned.

Miller has proposed a theory of the mental representation of meaning in which the addition of semantic components is the core organizing principle of the mental lexicon. ...This theory suggests that it should be possible to arrange word meanings in a hierarchy from the more general to the more specific. A more specific meaning is one where the concept of the parent has been elaborated (Collier & Fellbaum, 1988, p. 5-6).



Specifically, the further down the relational hierarchy structure (in the relational view's terms) or the more complex the word (in the compositional view's terms), the more information it conveys. For example, maple provides more specific information about a referent than tree. Similarly, stroll provides more information about an action than move.

In general, as the amount of information provided by a verb increases, the number or specificity of selectional restrictions for that verb increases. It should be easier to violate the selectional restrictions of a verb if it has a highly constraining selectivity than if it has relatively little selectivity. Thus, if walking selects for a subject which uses legs to move, any subject that does not fit this criteria violates the verb's selectional restrictions (e.g., anything that moves on wheels -cars, etc. or anything that is abstract -ideas, etc.). Generally, if a subject has wheels we consider it to roll, not walk. Note that walk and travel have a troponymic relation: to walk is to travel in some manner. Subjects that seem to violate the constraints of walk (e.g., The car walked along the avenue) do not necessarily violate the constraints of travel (e.g., The car traveled along the avenue). Similarly, travel and change also have a troponymic relation: to travel is to change in some manner. Subjects that seem to violate the constraints of travel do not necessarily violate the constraints of change. It seems that the more general the verb, the more difficult it is to violate its selectional restrictions. For example, it is difficult to come up with any subject that is not acceptable with the

verb change: animate, inanimate, concrete, and abstract subjects are all capable of change.

If selectional restriction violations are a source of a sense of metaphoricity, more complex or selective verbs should be more likely to be judged as metaphorical than more primitive or less selective verbs. For example, using walk metaphorically should be easier than using move metaphorically.

Gentner and France (1988) suggest that such violations may be promising cues to metaphorical use of verbs. They used a number of paraphrase tasks to investigate the interpretation of sentences in which verbs and nouns mismatched, or created a semantic strain, to varying degrees (e.g., The lizard worshipped). Therefore, some of these sentences reflect selectional restriction violations. They found that the verb, as opposed to the noun, was typically the locus of meaning change (e.g., The lizard stared unblinkingly at the sun). Moreover, they report that the greater the semantic strain, the more the meaning changed when paraphrased. However, they did not measure metaphoricity. Selectional restrictions and the structure of semantic information described above suggest a constrained, systematic way to investigate whether semantic strain results in a sense of metaphoricity.

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## *Chapter 3*

### *Experiment 1*

#### Ratings of Predicative Metaphors

The purpose of this experiment was to investigate the possibility that selectional restriction violations (or the typical matching of a noun with a verb) play a role in determining metaphoricity. Specifically, are some verbs more likely to be judged as being used metaphorically than others? Ratings of metaphoricity were collected to test whether violating selectional restrictions of a verb may be a source of a sense of metaphoricity. In addition, ratings of comprehensibility and aptness were collected to ensure the quality of stimuli for further experiments of predicative metaphor processing.

#### Method

##### Participants.

Sixty Princeton University undergraduates participated in this experiment: twenty-six males and thirty-four females, mean ages of 20.8 and 19.3 years, respectively. They were recruited through sign-up sheets that were posted in the Psychology building and were compensated with credit in a psychology course. All participants were native English speakers and none had previously participated in studies of metaphorical use of verbs.

Design and Materials.

A 2 (Noun-phrase) x 2 (Verb-type) x 3 (Noun-type) x 6 (List) mixed factorial was used. List was a between-Ss factor; Noun-phrase, Verb-type, and Noun-type were all within-Ss factors. Fifty-four sets of six types of sentences were used as items. Each six-sentence set reflected a Verb-type x Noun-type crossing.

A six-sentence set was created by selecting a pair of verbs from within the same semantic domain that reflected different levels of specificity, or informational value (e.g., related hierarchically by a manner of relation). Therefore, the two levels of Verb-type reflected that one verb of each pair can be considered more general, or as specifying less information, and that the other verb of each pair can be considered more specific, or as specifying more information. Table 1 provides examples of verb pairs.

Table 1: Examples of verb pairs reflecting the different informational value corresponding with each Verb-type level.

<u>Specific</u>		<u>General</u>
flew		travelled
uncorked		opened
danced		moved
kidnapped		stole
killed		rejected
garnished		decorated
melted		dissolved

Each verb pair was used with a different set of three nouns to create six sentences. Each triad of nouns was selected so that one noun did not violate the selectional restrictions of either verb, one noun violated only the selectional restrictions of one verb (i.e., the specific verb of the pair), and one noun violated the selectional restrictions of both verbs of the pair (i.e., both the specific and the general verb). Therefore, the three levels of Noun-type reflect the types of relationships with the selectional restrictions of the verbs that result when the nouns and verbs are used together: neither verb violated, one verb violated, both verbs violated. Note that, for each item set, this results in three sentences representing cases in which selectional restriction violations occur, and three sentences representing cases in which violations do not occur (see Table 2).

*Table 2:* Example of crossing Verb-type by Noun-type giving the resulting pattern of selectional restriction violations (\* indicates selectional restriction violation).

NOUNS	SPECIFIC VERB: "fly"	GENERAL VERB: "travel"
NO violations	BIRD	BIRD
ONE violation	BOY *	BOY
TWO violations	IDEA *	IDEA *

In addition, the triad of nouns for any particular item set was placed in either the subject or the object role of the sentence. Therefore, in twenty-seven of

the item sets the selectional restriction violations occurred with the subject noun phrase, while in the other twenty-seven of the item sets the selectional restriction violations occurred with the object noun phrase. Thus, the two levels of Noun-phrase reflect whether the selectional restrictions violations occurred with the subject or object role of the verbs. See Table 3 for examples of both subject and object noun phrase item sets and Appendix A for the full set of items.

*Table 3:* Examples of a six-sentence item set for both subject and object noun phrase item sets (\*indicates selectional restriction violation).

SUBJECT noun phrase item set:	
<i>Specific Verb</i>	<p>The <u>bird</u> grabbed the worm and <u>flew</u> across town.            *The <u>boy</u> jumped on his bike and <u>flew</u> across town.            *The <u>idea</u> <u>flew</u> across town.</p>
<i>General Verb</i>	<p>The <u>bird</u> grabbed the worm and <u>travelled</u> across town.            The <u>boy</u> jumped on his bike and <u>travelled</u> across town.            *The <u>idea</u> <u>travelled</u> across town.</p>
OBJECT noun phrase item set:	
<i>Specific Verb</i>	<p>He <u>garnished</u> the <u>meal</u>.            *He <u>garnished</u> the war <u>hero</u>.            *He <u>garnished</u> the <u>truth</u>.</p>
<i>General Verb</i>	<p>He <u>decorated</u> the <u>meal</u>.            He <u>decorated</u> the <u>hero</u>.            *He <u>decorated</u> the <u>truth</u>.</p>

The 324 total sentences (fifty-four sets of six sentences) were counterbalanced across six lists. The six lists were constructed so that a pair of

sentences from every item set appeared on every list. Thus, an equal number of subject noun phrase and object noun phrase item sets were represented per list.

From each set, sentences were paired with the constraint that neither of the verbs nor any of the nouns could appear in both sentences of the pair. Therefore, both verbs and two of the nouns from every item set were used in the sentences assigned to each list. This results in six possible types of pairings of sentences within a set. Each pairing reflects a combination of different types of sentences. The six possible pairings can be described accordingly: in one pair neither sentence expresses selectional restriction violations, in four of the pairs one sentence does and one does not exhibit selectional restriction violations, and in the last pair both sentences exhibit selectional restriction violations. All six possible pairs from every set were used, with one pair appearing on each list. Therefore, each sentence was represented equally across all six lists.

For all item sets, the six pair types were quasi-randomly assigned to the six lists so that an equal number of pair types per list was maintained. Given that, on any one list, one of six pair types from each of fifty-four sets was represented, this resulted in nine examples of each pair type per list. As far as possible, an equal number of pair types from both subject and object noun phrase sets per list was also maintained. However, there were 27 item sets of each level of Noun-phrase. Therefore, four of the nine examples of each pair type were from subject noun phrase sets and four were from object noun phrase sets. The remaining example of each pair type was balanced across the six lists between the three item

sets for each Noun-phrase level that was leftover. Across all lists, an equal number of sentences exhibiting selectional restriction violations, and those that did not, was maintained.

Therefore, a pair of sentences from fifty-four item sets gave a total of 108 sentences per list; each set was represented by more than one sentence for a subject. For each list, the sentences were presented in a unique randomized order with the constraint that no more than 7 sentences with, or without, selectional restriction violations were presented in a row. Three sentences and their ratings scales were presented per page of the list packet.

#### Procedure.

Participants were informed that the experiment concerned how people understand figurative language, such as metaphor, and that they would be asked to make various judgments about sentences. Each participant was tested individually and randomly assigned to receive one of the six lists. Once situated in a quiet room, participants were given a packet with the following instructions appearing on the cover sheets:

#### Ratings Study Instructions

We are interested in how people understand various types of expressions. In this study, we are particularly interested in how people understand figurative, or non-literal, statements. You will be given a number of sentences to read and then to rate on three dimensions: for ease of comprehension (how easy it was to understand), for degree of metaphoricity (how non-literal or literal it was), and finally for aptness (how well or poorly it expresses its meaning).

Read each sentence carefully, then rate that statement in terms of how easy it was to understand. A rating of 1 means that you did not understand it at all. A rating of 7 means that you understood it perfectly well, and that it was easy to understand.



Intermediate ratings should reflect different degrees of ease of understanding. For example, a rating of 2 would indicate that it was very difficult to understand, while a rating of 5 or 6 would indicate that it was relatively easy to understand.

After you have rated the statement for comprehensibility, rate the statement in terms of how metaphorical it seems to you. A rating of 1 means that you judged the statement as not metaphorical at all. A rating of 7 means that you judged it to be extremely metaphorical. For example, the statement Apples are fruit is not metaphorical at all - it is a literal statement, and therefore might be rated as a 1. However, Some lectures are sleeping pills might be rated as a 7 since it is not a literal statement and is very metaphorical. Again, intermediate ratings should reflect different degrees of literalness and metaphoricalness.

Finally, once you have rated the metaphoricity of the statement, rate the statement in terms of how apt it seems to you. Aptness refers to how good a metaphor is. A metaphor can be very easy to understand, yet not be a very good metaphor. For example, the meaning of a metaphor such as My job is a penitentiary is virtually identical to the meaning of the metaphor My job is a jail, but many people feel that the penitentiary expression is less apt, perhaps somewhat awkward. A rating of 1 means that the metaphor is not at all apt; a rating of 7 means that it is a perfectly apt metaphor. Intermediate ratings indicate intermediate degrees of metaphor goodness.

Below are examples of scales from 1 to 7 for the three different dimensions that will follow each statement. For each statement please circle the number indicating your judgment for comprehensibility, metaphoricity, and aptness:

1	2	3	4	5	6	7
not at all						extremely
comprehensible						comprehensible
1	2	3	4	5	6	7
not at all						extremely
metaphorical						metaphorical
1	2	3	4	5	6	7
not at all						extremely
apt						apt

For each sentence, try to use your best judgment. For many sentences this will be easy. For others, you may have some difficulty coming to a judgment. Remember, there are no right or wrong answers ... we are interested in YOUR judgments, and ask that you provide all ratings for each sentence.

Take a few minutes to look through the booklet to get some notion as to the range of phrases you will be judging. Once you have familiarized yourself with the material and have asked any questions you may have, you may continue.

Remember, there are no right or wrong answers. We are interested in YOUR judgments. If you have any questions, please ask the experimenter. If not, proceed.

After reading the instructions, any questions that the participant asked were answered, and then the participant proceeded through the packet. The packets took approximately 30 minutes to complete, ranging from 20 minutes up to an hour. Once participants completed the ratings, they were debriefed and any questions were answered.

## Results and Discussion

### Comprehensibility Ratings

The mean comprehension ratings as a function of sentence type are presented in Table 4. High ratings of sentences indicate that participants judged the item to be more comprehensible than sentences with lower ratings. The overall comprehensibility rating for all sentences was 6.08, with the average rating per sentence ranging from 3.3 to 7 on a scale from 1 to 7, suggesting that the sentences are generally easy to understand.

The sentences belonging to the item sets for which selectional restriction violations occurred with the subject noun phrase were rated more comprehensible than sentences belonging to item sets for which violations occurred with the object noun phrase: mean rating for subject noun phrase was 6.24 and for object noun phrase was 5.92. In addition, sentences with general verbs were rated more

comprehensible than those with specific verbs, 6.2 and 5.97, respectively. Mean ratings of sentences decreased in comprehensibility according to the degree of selectional restriction violations indicated by Noun-type levels: 6.41 no verbs violated, 6.16 one verb violated (i.e., the specific verb), 5.69 both verbs violated.

*Table 4:* Mean comprehensibility rating by condition type (\*indicates selectional restriction violation).

<u>SUBJECT noun phrase</u>				
<u>Noun-type</u>		<u>Verb-type</u>		
	<u>Specific Verb</u> <i>FLEW</i>		<u>General Verb</u> <i>TRAVELLED</i>	
No violations	bird flew	6.50	bird travelled	6.41
One violation	*boy flew	6.22	boy travelled	6.53
Two violations	*idea flew	5.89	*idea travelled	5.92
<u>OBJECT noun phrase</u>				
<u>Noun-type</u>		<u>Verb-type</u>		
	<u>Specific Verb</u> <i>GARNISH</i>		<u>General Verb</u> <i>DECORATE</i>	
No violations	garnished meal	6.42	decorated meal	6.31
One violation	*garnished hero	5.48	decorated hero	6.42
Two violations	*garnished truth	5.32	*decorated truth	5.60

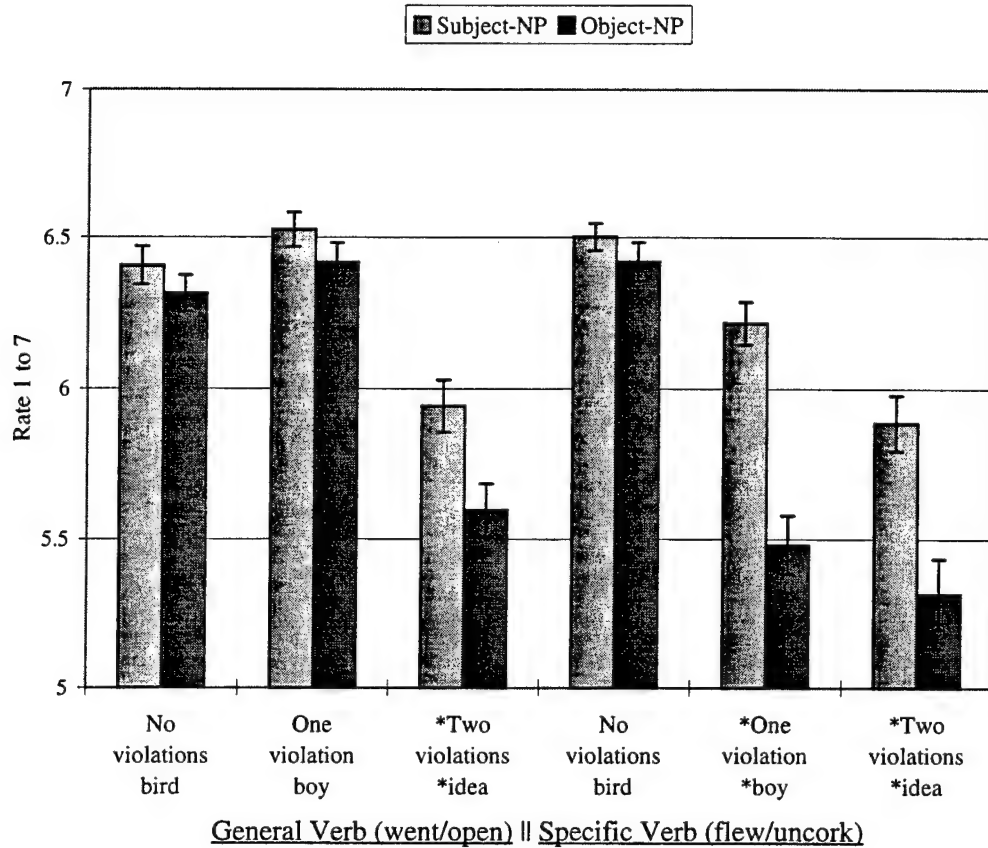
Results from 2 Noun-phrase (subject vs. object) x 2 Verb-type (general vs. specific) x 3 Noun-type (violates verbs: none vs. one vs. both) analyses of variance (ANOVA) are reported. Separate analyses were performed with subjects (Fs) and items (Fi) as random factors. All three variables are within-subjects factors in the subjects analysis, and between-items factors in the items analysis.

Types of sentences varied reliably in comprehensibility judgments. Both subjects and items ANOVAs revealed significant main effects for all factors. There were also reliable interactions for both analyses between Verb-type and Noun-phrase  $F_s(1, 59) = 31.46, p < .001$ ;  $F_i(1, 312) = 4.14, p < .05$ , as well as between Verb-type and Noun-type  $F_s(2, 118) = 29.73, p < .001$ ;  $F_i(2, 312) = 9.06, p < .001$ . In addition, in the subject analysis there was a significant Noun-type by Noun-phrase interaction  $F_s(2, 118) = 16.00, p < .001$ , as well as a significant Noun-phrase by Verb-type by Noun-type interaction  $F_s(2, 118) = 11.33, p < .001$ .

#### Simple effects analyses

Simple effects analyses were done for both subjects and items analyses to reveal the nature of the interactions. In short, these analyses showed that when selectional restriction violations occurred, the sentences were rated as less comprehensible than sentences in which there were no such violations (see Figure 1). Specifically, one level of Noun-type varied as to whether it caused a violation of selectional restrictions depending on with which Verb-type it was paired (e.g., boy with \*fly/travelled or \*uncorked/opened with bottle). Therefore, a Noun-type by Verb-type crossing results in a built-in pattern of an interaction of selectional restriction violations: a general verb was violated by one noun type and a specific verb was violated by two noun types.

### Comprehensibility Ratings

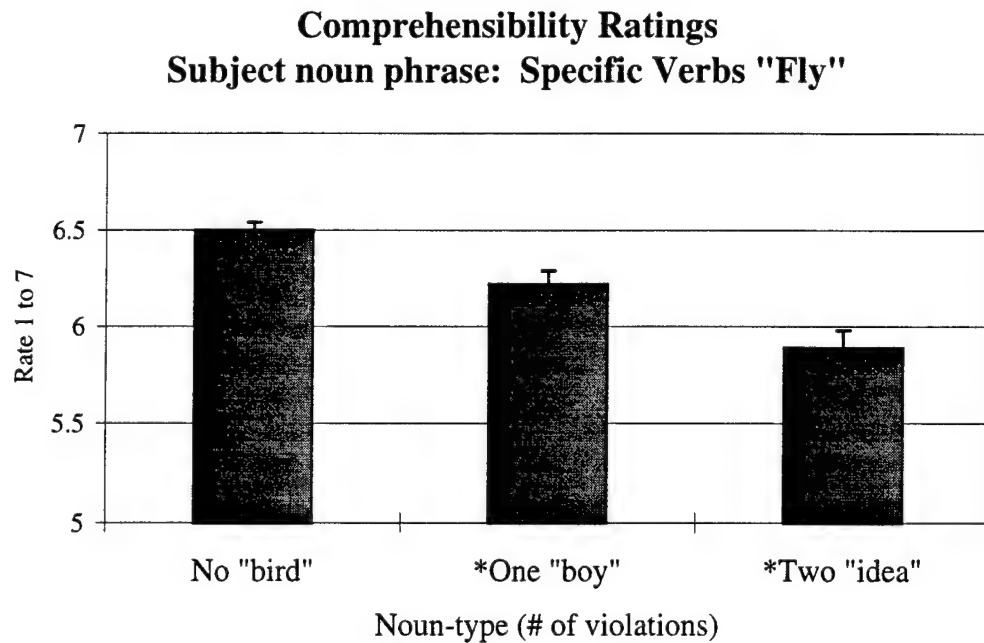


*Figure 1:* Mean comprehensibility rating by sentence type (\*indicates selectional restriction violation).

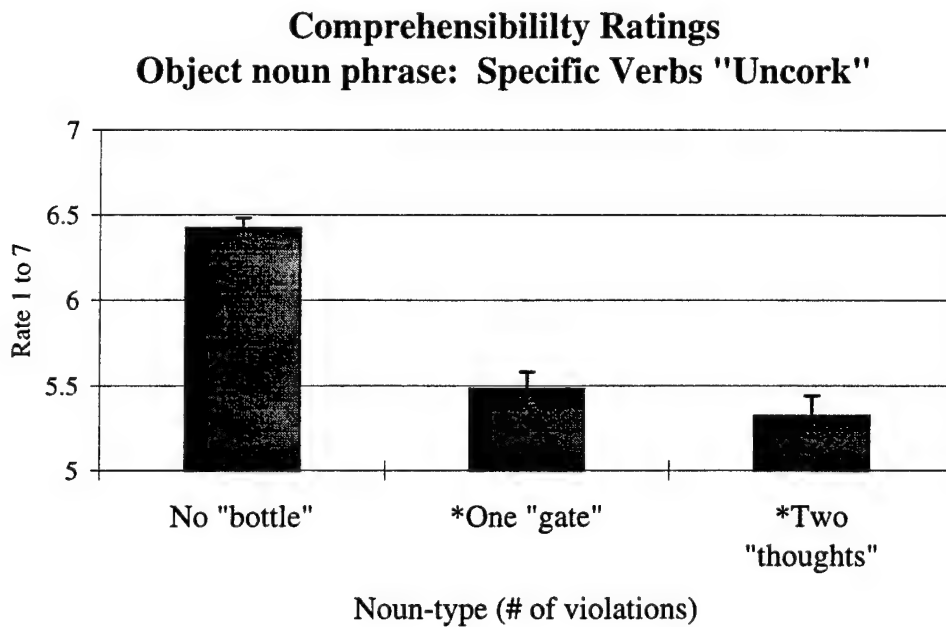
The mean comprehensibility ratings as a function of Noun-type, broken down by Noun-phrase and Verb-type levels, are presented in Figures 2-5. Simple effects treating subjects as random factors showed that when paired with specific verbs (e.g., fly/uncork), all three levels of Noun-type differed significantly from each other for both subject and object noun phrase sentences. Sentences that

contained nouns that did not violate selectional restrictions of either verb (e.g., No bird/bottle in figures) were rated most comprehensible. Sentences with nouns that violated the selectional restrictions of only the specific verb (e.g., One boy/gate in figures), and thus did so in this case, followed in comprehensibility. Finally, sentences with nouns that violated the selectional restrictions of both the specific and general verbs (e.g., Two idea/thoughts in figures) were rated least comprehensible (see Appendix B for values of all relevant effects). Note that for these sentences two levels of selectional restrictions were violated, i.e., both idea flew and idea travelled (or uncork thoughts and open thoughts) exhibit restriction violations. The difference between the ratings of sentences with the last two noun types (i.e., one and two violation conditions) suggests that not only were comprehensibility ratings influenced by whether a violation occurred, but that levels or degree of violation also played a role in comprehensibility judgments.

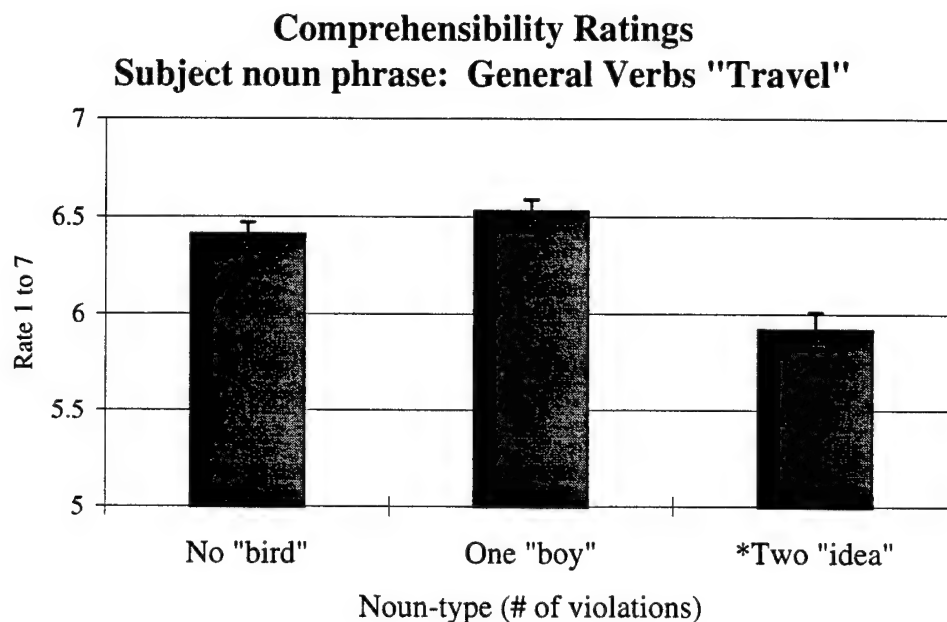
When paired with general verbs (e.g., travel/open), however, only nouns that violate the restrictions of both verbs (e.g., Two idea/thoughts) were significantly different from the other two noun types (e.g., No bird/bottle and One boy/gate), which did not differ from each other. Again, this pattern was found for both subject and object noun phrase sentences. Recall that these are the only sentences with general verbs that exhibit selectional restriction violations: No nouns violate neither verb and One nouns violate only the specific verb. Also note that, in contrast to when paired with a specific verb, only one level of selectional restrictions is violated by these nouns in this case.



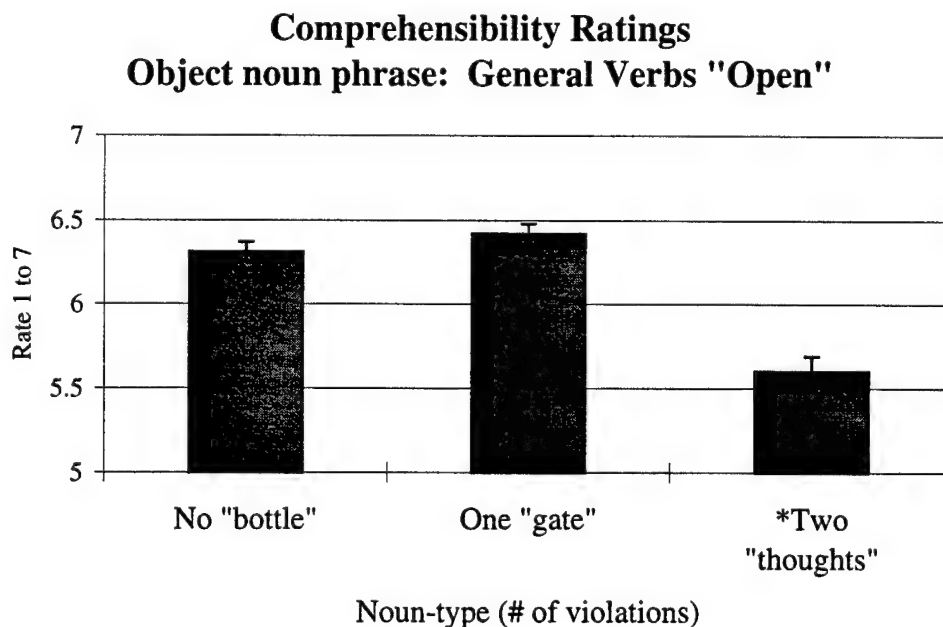
*Figure 2:* Mean comprehensibility rating as a function of Noun-type for subject noun phrase sentences with specific verbs, e.g., "fly" (\*indicates selectional restriction violation).



*Figure 3:* Mean comprehensibility rating as a function of Noun-type for object noun phrase sentences with specific verbs, e.g., "uncork" (\*indicates selectional restriction violation).



*Figure 4:* Mean comprehensibility rating as a function of Noun-type for subject noun phrase sentences with general verbs, e.g., "travel" (\*indicates selectional restriction violations).



*Figure 5:* Mean comprehensibility rating as a function of Noun-type for object noun phrase sentences with general verbs, e.g., "open" (\*indicates selectional restriction violations).

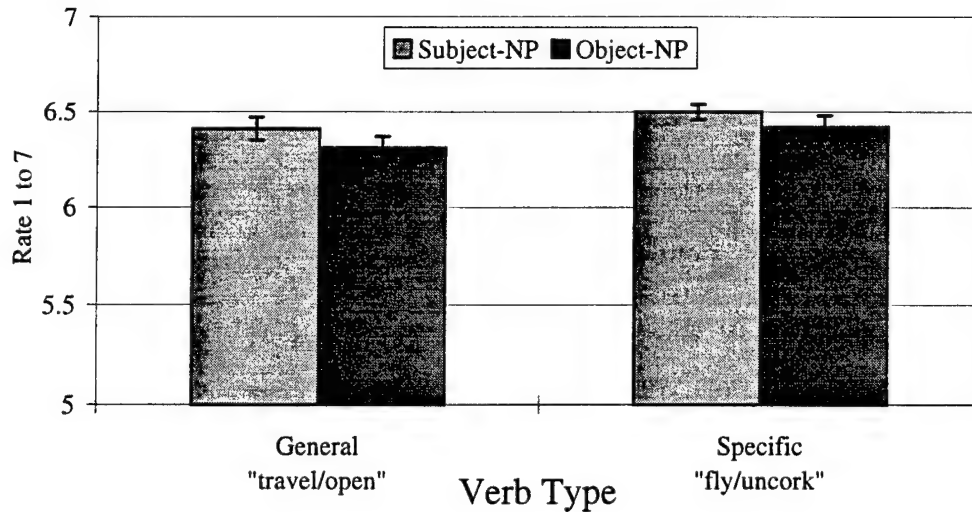


Simple effects analyses treating items as random factors showed a different pattern (see Figures 2-5). Consistent with treating subjects as random, sentences in which general verbs (e.g., travel/open) were paired with nouns that violate the restrictions of both verbs (e.g., Two idea/thoughts), were rated significantly less comprehensible than the other two noun types (e.g., No bird/bottle and One boy/gate), which did not differ from each other. Once again, this was the case for both subject and object noun phrase sentences. In contrast to the subjects analysis, however, specific verb sentences did not show differences between all three levels of Noun-type for the items analysis. Subject noun phrase sentences with specific verbs (e.g., fly) followed the same pattern as the general verbs: sentences with nouns that violate both verbs (e.g., Two idea) were rated significantly less comprehensible than the other two Noun-type levels (e.g., No bird and One boy), which did not differ. Thus, sentences that exhibit selectional restriction violations to a lesser degree, e.g., The boy flew across town, did not differ from sentences that do not violate selectional restrictions, e.g., The bird flew across town. Object noun phrase sentences with specific verbs (e.g., uncork) were rated according to whether selectional restriction violations occurred: when used with nouns that did not violate either verb (e.g., No bottle), sentences were more comprehensible than when used with either of the other two noun types that did violate the verb (e.g., One gate and Two thoughts), and which did not differ from one another. Thus, object noun phrase sentences that exhibit selectional restriction violations, e.g., She uncorked the gate or She uncorked her thoughts,

did not vary according to degree of violation, but were less comprehensible than sentences that did not violate restrictions, e.g., She uncorked the bottle of wine.

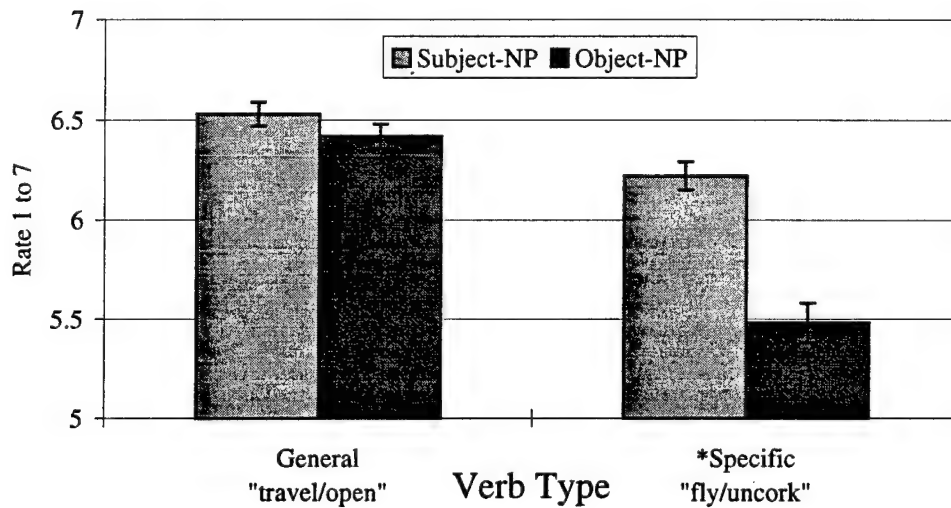
The mean comprehensibility ratings as a function of Noun-phrase by Verb-type, broken down by levels of Noun-type, are presented in Figures 6-8. The higher-order 3-way interaction in the subjects analysis reflects that the relationship between levels of Verb-type differed for subject and object noun phrase sentences at only one level of Noun-type. When nouns did not violate either verb type (e.g., No bird/bottle), general and specific verbs did not differ significantly in either subject or object noun phrase sentences. When nouns violated only the specific verb (e.g., One boy/gate), sentences with general verbs were rated significantly more comprehensible than sentences with specific verbs. Thus, sentences violating selectional restrictions are less comprehensible. Again, this was consistent in both the subject and object noun phrase sentences of this type. However, when nouns violated both verbs (e.g., Two idea/thoughts), ratings of subject and object noun phrase sentences differed. In object noun phrase sentences, when nouns of this type were used with a general verb (e.g., open thoughts), sentences were rated significantly more comprehensible than when used with a specific verb (e.g., uncork thoughts). In contrast, for subject noun phrase sentences there was no significant difference between nouns of this type being used with general and specific verbs. Thus, sentences like She uncorked her thoughts and She opened her thoughts differed significantly, whereas The idea flew and The idea travelled did not.

### Comprehensibility Ratings No violations: "bird/bottle"



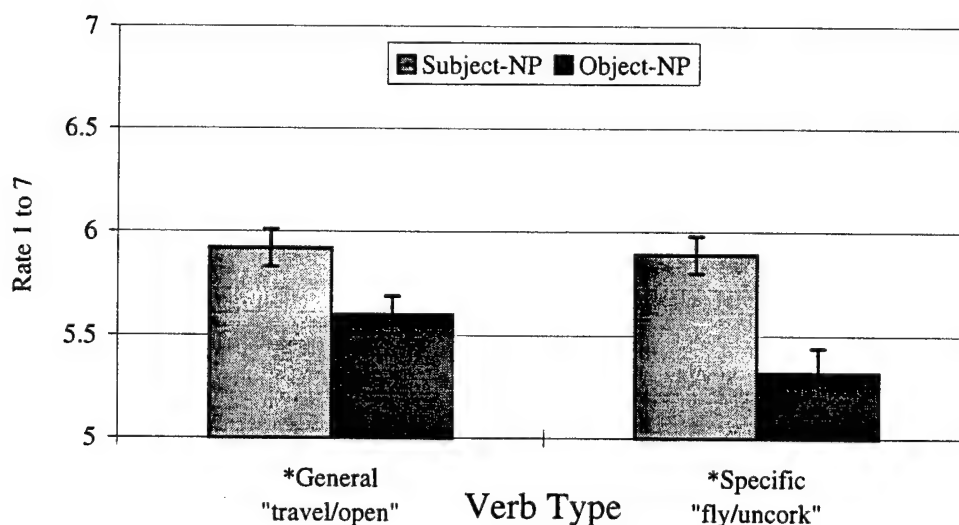
*Figure 6:* Mean comprehensibility rating as a function of Verb-type by Noun-phrase for sentences with nouns that do not violate either verb, e.g., "bird/bottle".

### Comprehensibility Ratings One violation: "boy/gate"



*Figure 7:* Mean comprehensibility rating as a function of Verb-type by Noun-phrase for sentences with nouns that violate the specific verb, e.g., "boy/gate" (\*indicates selectional restriction violations).

### Comprehensibility Ratings Two violations: "idea/thoughts"



*Figure 8:* Mean comprehensibility rating as a function of Verb-type by Noun-phrase for sentences with nouns that violate both verbs, e.g., "idea/thoughts" (\*indicates selectional restriction violations).

According to simple effects treating items as random, there were no significant differences between Verb-type or Noun-phrase for sentences with nouns that did not violate either verb. There was also no difference between Verb-type for sentences with nouns that violated both verbs, although subject noun phrase sentences were significantly more comprehensible than the object noun phrase sentences of this type. Finally, there was an interaction between Verb-type and Noun-phrase for sentences with nouns that violated only the specific verb. General verb sentences, which did not exhibit selectional restriction violations, were rated more comprehensible than cases in which there were violations (i.e., with the specific verb). There was a difference between subject

and object noun phrase sentences in the specific verb sentences only: subject noun phrase sentences were more comprehensible than object noun phrase sentences.

Overall, selectional restriction violations influenced comprehensibility ratings. Sentences in which the verb's selectional restrictions were violated were less comprehensible than those in which violations did not occur. One reason for collecting comprehensibility judgments was to ensure that items were comprehensible for further tests of metaphor processing. Overall, this was the case. However, any sentence with a comprehensibility rating of 4.0 or lower (a total of 4 sentences), along with its item set, was excluded from further analyses of metaphoricity judgments.

#### Metaphoricity Ratings

The data for items with and without selectional restriction violations were trimmed separately. For items with selectional restriction violations, the data were trimmed by excluding data points 2.5 standard deviations below the mean for those items (3 sentences total: 1 subject and 2 object noun phrase). For items without selectional restriction violations, the data were trimmed by excluding data points 2.5 standard deviations above the mean for those items (4 sentences total: 2 subject and 2 object noun phrase). In addition, the entire corresponding item set for these sentences was excluded from further analyses. A total of 43 item sets (i.e., 23 subject and 20 object noun phrase item sets) were included in analyses of metaphoricity judgments.

The mean metaphoricity ratings as a function of sentence type are presented in Table 5. High ratings of sentences indicate that participants judged the item to be more metaphorical than sentences with lower ratings. The overall metaphoricity ratings for all sentences was 3.82 with the average rating per sentence ranging from 1 to 6.85 on a scale from 1 to 7. Sentences with selectional restriction violations had a mean metaphoricity rating of 5.36, while those in which no selectional violations occurred had a mean rating of 2.29. Thus, sentences in which selectional restriction violations occur were, overall, judged as more metaphorical.

*Table 5:* Mean metaphoricity rating by condition type (\*indicates selectional restriction violation).

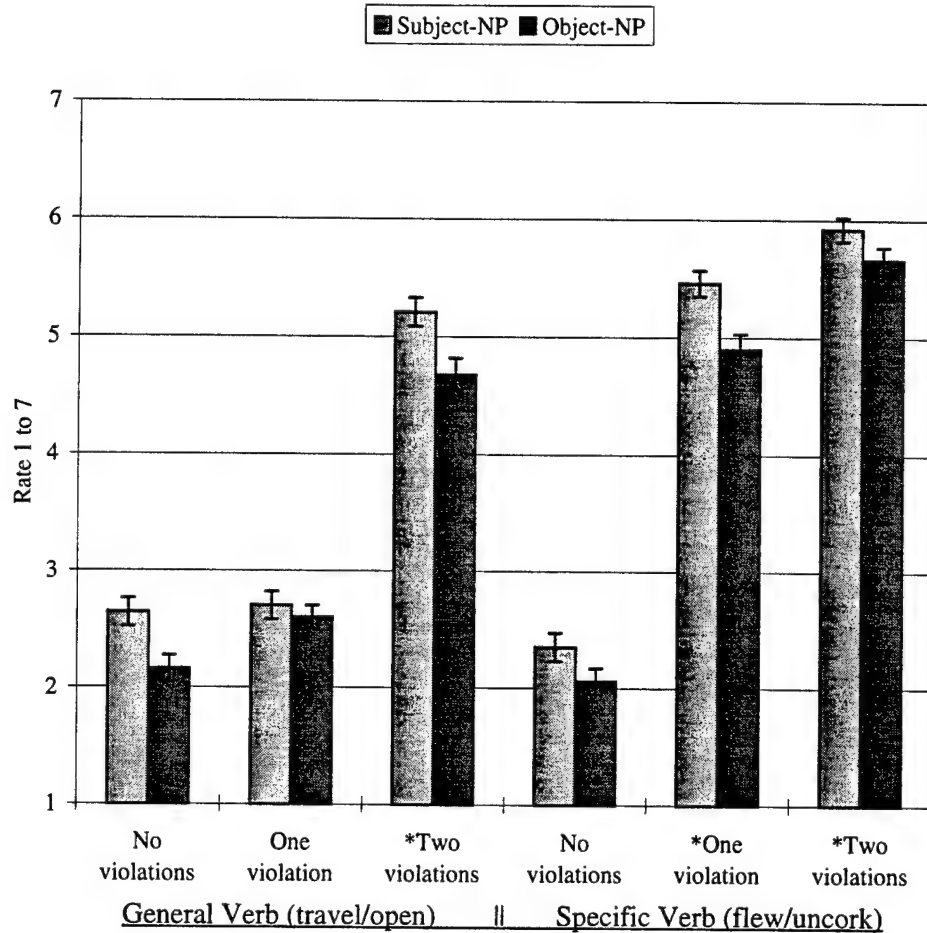
<u>SUBJECT noun phrase</u>				
<u>Noun-type</u>		<u>Verb-type</u>		
	<u>Specific Verb</u>		<u>General Verb</u>	
	<u>FLEW</u>		<u>TRAVELLED</u>	
No violations	bird flew	2.35	bird travelled	2.64
One violation	*boy flew	5.46	boy travelled	2.70
Two violations	*idea flew	5.92	*idea travelled	5.21
<u>OBJECT noun phrase</u>				
<u>Noun-type</u>		<u>Verb-type</u>		
	<u>Specific Verb</u>		<u>General Verb</u>	
	<u>GARNISH</u>		<u>DECORATE</u>	
No violations	garnished meal	2.06	decorated meal	2.16
One violation	*garnished hero	4.90	decorated hero	2.60
Two violations	*garnished truth	5.66	*decorated truth	4.68

The sentences belonging to the item sets for which selectional restriction violations occurred with the subject noun phrase were rated more metaphorical than sentences belonging to item sets for which violations occurred with the object noun phrase: mean ratings for subject noun phrase was 3.99 and for object noun phrase was 3.62. In addition, sentences with specific verbs were rated more metaphorical than those with general verbs, 4.37 and 3.27, respectively. Mean ratings of metaphoricity of sentences decreased according to Noun-type levels of selectional restriction violations: 5.4 both verbs violated, 3.9 one verb violated (i.e., the specific verb), and 2.15 no verbs violated.

Results from 2 Noun-phrase (subject vs. object) x 2 Verb-type (general vs. specific) x 3 Noun-type (violates verbs: none vs. one vs. both) analyses of variance (ANOVA) are reported, with separate analyses performed with subjects ( $F_s$ ) and items ( $F_i$ ) as random factors. All three variables are within-subjects factors in the subjects analysis, and between-items factors in the items analysis.

As predicted, metaphoricity judgments varied reliably according to whether selectional restriction violations occurred (see Figure 9). Both subjects and items ANOVAs revealed significant main effects for all factors. There were also reliable interactions for both analyses between Verb-type and Noun-type  $F_s(2, 116) = 305.79, p < .001$ ;  $F_i(2, 246) = 70.51, p < .001$ . In addition, there was a significant interaction of Verb-type by Noun-type by Noun-phrase in the subjects analysis  $F_s(2, 116) = 9.07, p < .001$ .

### Metaphoricity Ratings



*Figure 9:* Mean metaphoricity rating as a function of sentence type (\*indicates selectional restriction violation).

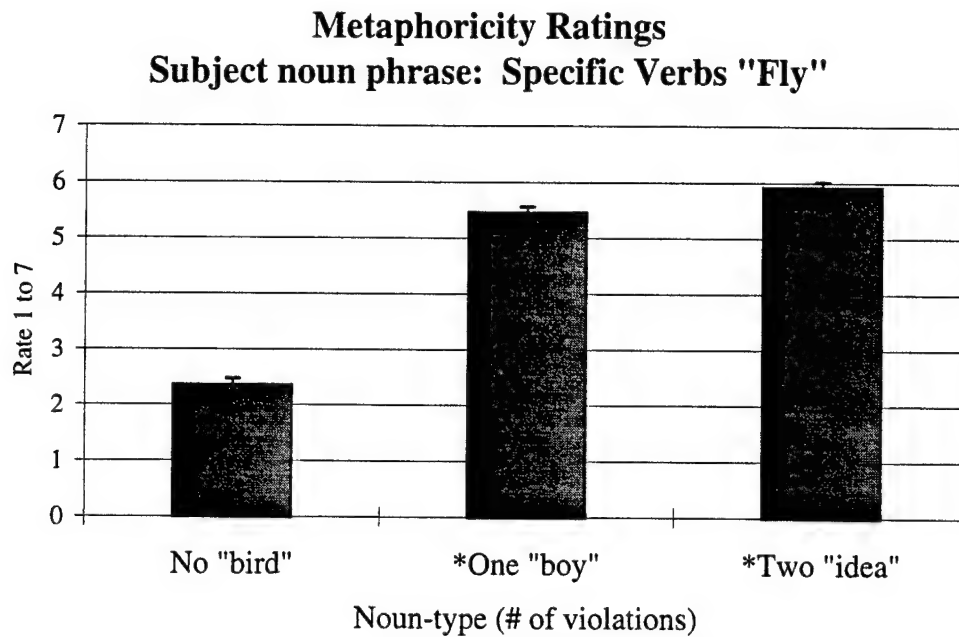
#### Simple effects analyses

Simple effects analyses were done for both subjects and items analyses to investigate the pattern of results. In short, these analyses showed that sentences with selectional restriction violations were rated as more metaphorical than

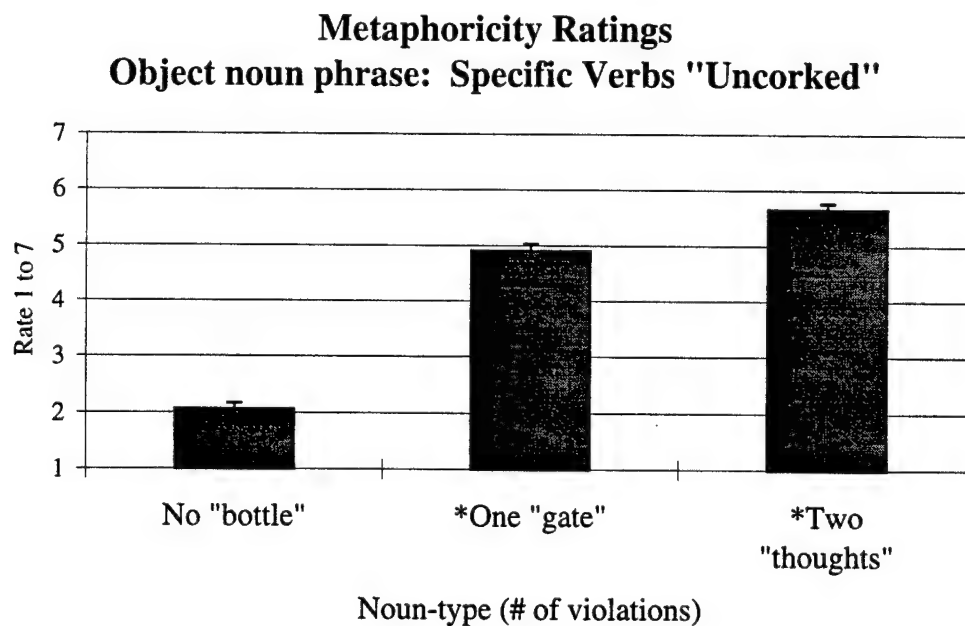


sentences in which there were no such violations. Furthermore, the degree of metaphoricity was a function of the degree of violation.

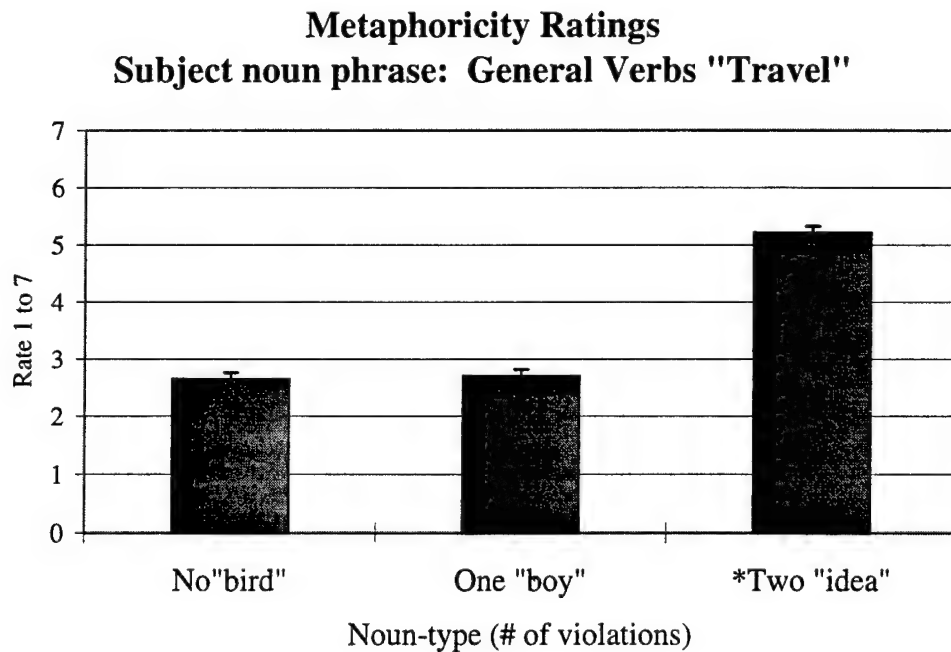
Simple effects treating subjects as random factors investigated the nature of the three-way interaction. The mean metaphoricity ratings as a function of Noun-type, broken down by Noun-phrase and Verb-type levels, are presented in Figures 10-13. The Verb-type by Noun-type interaction was significant for both subject and object levels of Noun-phrase. All three levels of Noun-type (i.e., no, one, and two violations) differed significantly from each other when paired with specific verbs (e.g., fly/uncork) in both subject and object noun phrase sentences. In addition, all three Noun-type levels differed when paired with general verbs in object noun phrase sentences. As the number of selectional restrictions increased, metaphoricity ratings increased: no violation nouns (e.g., bird/bottle) were judged the least metaphorical, followed by one violation nouns (e.g., boy/gate), and two violation nouns (e.g., idea/thoughts) were judged the most metaphorical. In the case of subject noun phrase sentences with general verbs (e.g., travel), no violation and one violation nouns did not differ from one another (e.g., bird and boy). Note that in both cases, no selectional restriction violations occur. Both of these conditions were significantly different from the two violation nouns (e.g., idea) in which violations do occur (see Appendix B for values of all relevant effects).



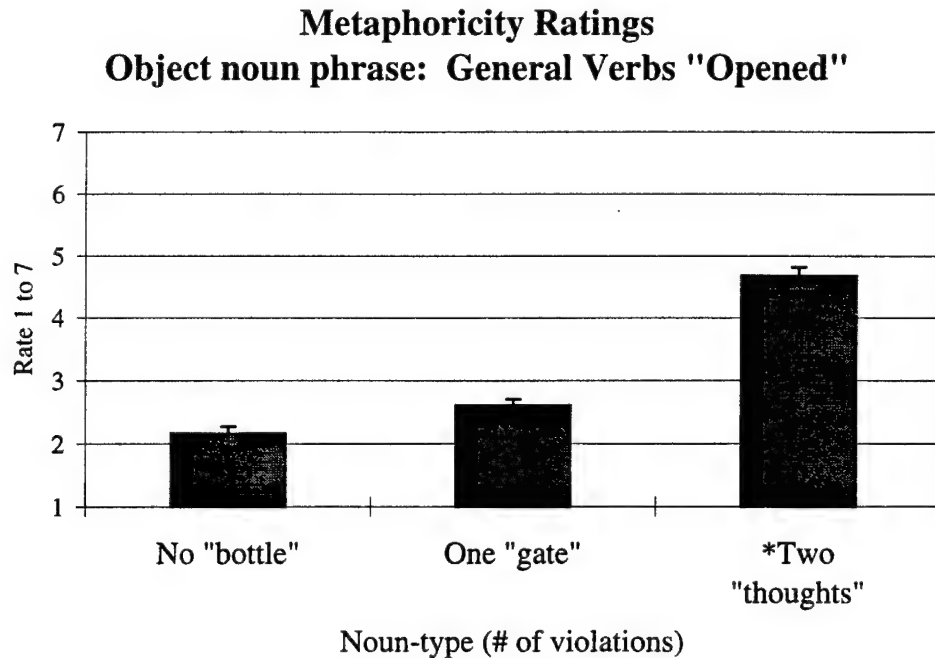
*Figure 10:* Mean metaphoricity judgments as a function of Noun-type for subject noun phrase sentences with specific verbs, e.g., "fly" (\*indicates selectional restriction violations).



*Figure 11:* Mean metaphoricity judgments as a function of Noun-type for object noun phrase sentences with specific verbs, e.g., "uncork" (\*indicates selectional restriction violations).

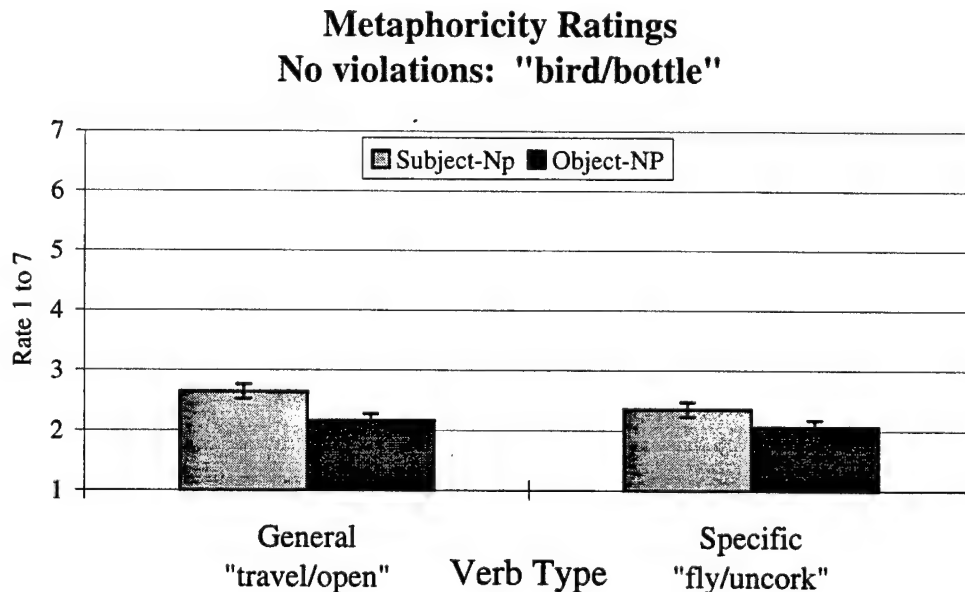


*Figure 12:* Mean metaphoricity judgments as a function of Noun-type for subject noun phrase sentences with general verbs, e.g., "travel" (\*indicates selectional restriction violation).

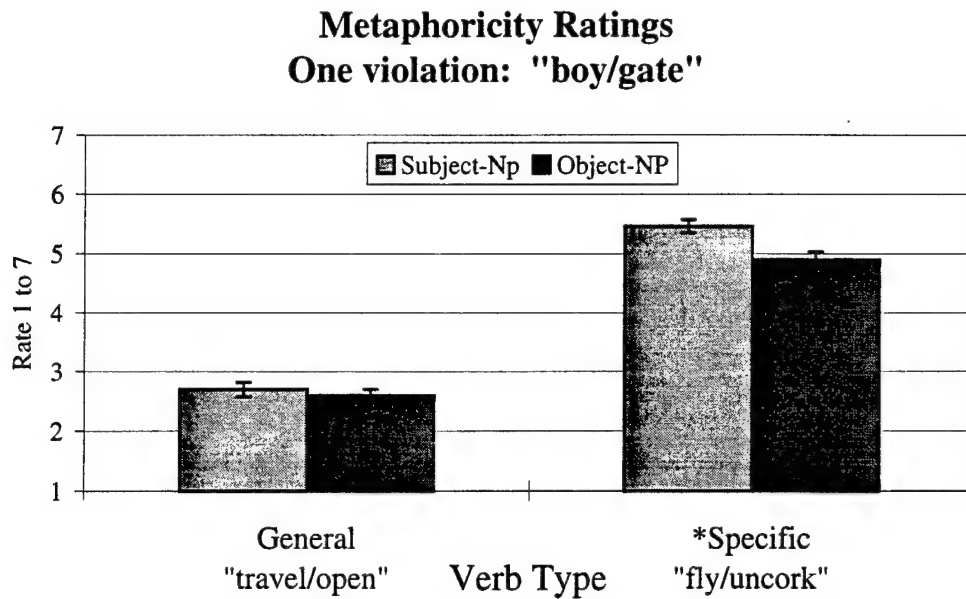


*Figure 13:* Mean metaphoricity judgments as a function of Noun-type for object noun phrase sentences with general verbs, e.g., "open" (\*indicates selectional restriction violations).

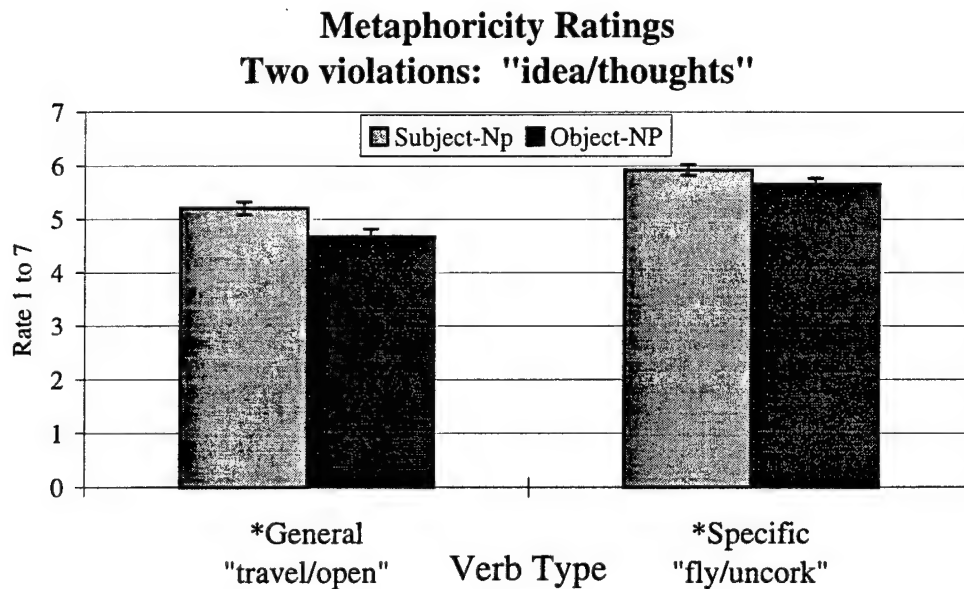
The mean metaphoricity ratings as a function of Noun-phrase by Verb-type, broken down by levels of Noun-type, are presented in Figures 14-16. Verb-type comparisons showed that the specific verb sentences were rated more metaphorical than the general verb sentences in all cases except for the no violation noun sentences (e.g., bird/bottle). In the object noun phrase sentences, there was no difference between specific and general verb sentences with nouns that did not violate either verb (e.g., uncork bottle/open bottle). In the subject noun phrase sentences, the general verb sentences were judged more metaphorical than the specific verb sentences with nouns that did not violate either verb. Thus, sentences like She opened the bottle and She uncorked the bottle were not significantly different, whereas, The bird travelled was rated significantly more metaphorical than The bird flew.



*Figure 14:* Mean metaphoricity judgments as a function of Verb-type by Noun-phrase for sentences with nouns that do not violate either verb, e.g., "bird/bottle".



*Figure 15:* Mean metaphoricity judgments as a function of Verb-type by Noun-phrase for sentences with nouns that violate the specific verb, e.g., "boy/gate" (\*indicates selectional restriction violations).



*Figure 16:* Mean metaphoricity judgments as a function of Verb-type by Noun-phrase for sentences with nouns that violate both verbs, e.g., "idea/thoughts" (\*indicates selectional restriction violations).

Simple effects treating items as random factors investigated its corresponding Verb-type by Noun-type interaction (see Figures 14-16). For sentences with nouns that did not violate the selectional restrictions of either type of verb (e.g., bird/bottle), there was no difference of Verb-type, but subject noun phrase sentences were judged more metaphorical than object noun phrase sentences. For sentences with nouns that violated only the specific verb (e.g., boy/gate), there was an effect of both Verb-type and Noun-phrase. Specific verb sentences (e.g., flew/uncork) were judged more metaphorical than general verb sentences (e.g., travel/open). In other words, cases in which selectional restriction violations occurred with this level of noun were judged as more metaphorical. Again, subject noun phrase sentences were judged more metaphorical than object noun phrase sentences. Finally, for sentences with nouns that violated the selectional restrictions of both verb types (e.g., idea/thoughts), the specific verb sentences were judged to be more metaphorical than the general verb sentences. For example, The idea flew across town and She uncorked her thoughts were judged as more metaphorical than The idea travelled across town and She opened her thoughts. In the case of this final level of Noun-type, there was no difference between levels of Noun-phrase. Note that selectional restriction violations occur at both levels of Verb-type for this noun type. Therefore, this suggests that not only does the violation of selectional restrictions of verbs influence judgments of metaphoricity, but that the degree of metaphoricity is influenced by the degree to which these violations occur. These results are consistent with Gentner and

France's (1988) finding that the more a noun mismatched a verb, creating semantic strain, the more the interpreted meaning changed.

Overall, selectional restriction violations influenced metaphoricity ratings. Sentences in which the verb's selectional restrictions were violated were more metaphorical than those in which violations did not occur. Thus, sentences such as The bird flew, The bird travelled, and The boy travelled were judged to be the least metaphorical, or literal. Sentences such as The boy flew and The idea travelled, each of which violates the selectional restrictions of the verb, were rated as metaphorical. However, sentences such as The idea flew were rated even more metaphorical. Recall that in this case, the selectional restriction violations occur at two levels. For example, not only do ideas violate the verb fly, in that they do not have wings, but they also do not even typically travel.

#### Aptness Ratings

The mean aptness ratings as a function of sentence type are presented in Table 6. High ratings of sentences indicate that participants judged the item to be more apt than sentences with lower ratings. The overall aptness ratings for all sentences was 4.7, with the average rating per sentence ranging from 1.7 to 6.65 on a scale from 1 to 7.

The sentences belonging to the item sets for which selectional restriction violations occurred with the subject noun phrase were rated more apt than sentences belonging to item sets for which violations occurred with the object

noun phrase: mean ratings for subject noun phrase was 4.96 and for object noun phrase was 4.43. In addition, sentences with general verbs were rated more apt than those with specific verbs, 4.79 and 4.60, respectively.

*Table 6:* Mean aptness rating by condition type (\*indicates selectional restriction violation).

<u>SUBJECT noun phrase</u>				
<u>Noun-type</u>		<u>Verb-type</u>		
	<u>Specific Verb</u> <i>FLEW</i>		<u>General Verb</u> <i>TRAVELLED</i>	
No violations	bird flew	5.09	bird travelled	4.98
One violation	*boy flew	4.95	boy travelled	5.24
Two violations	*idea flew	4.73	*idea travelled	4.78
<u>OBJECT noun phrase</u>				
<u>Noun-type</u>		<u>Verb-type</u>		
	<u>Specific Verb</u> <i>GARNISH</i>		<u>General Verb</u> <i>DECORATE</i>	
No violations	garnished meal	5.12	decorated meal	4.58
One violation	*garnished hero	3.76	decorated hero	5.06
Two violations	*garnished truth	3.97	*decorated truth	4.10

The mean aptness rating for sentences with selectional restriction violations was 4.38, ranging from 1.7 to 6.45. For sentences without selectional restriction violations, the mean aptness rating was 5.01, ranging from 2.6 to 6.65. One goal of collecting aptness ratings was to ensure that the predicative metaphors to be used to investigate dual reference in subsequent studies are apt



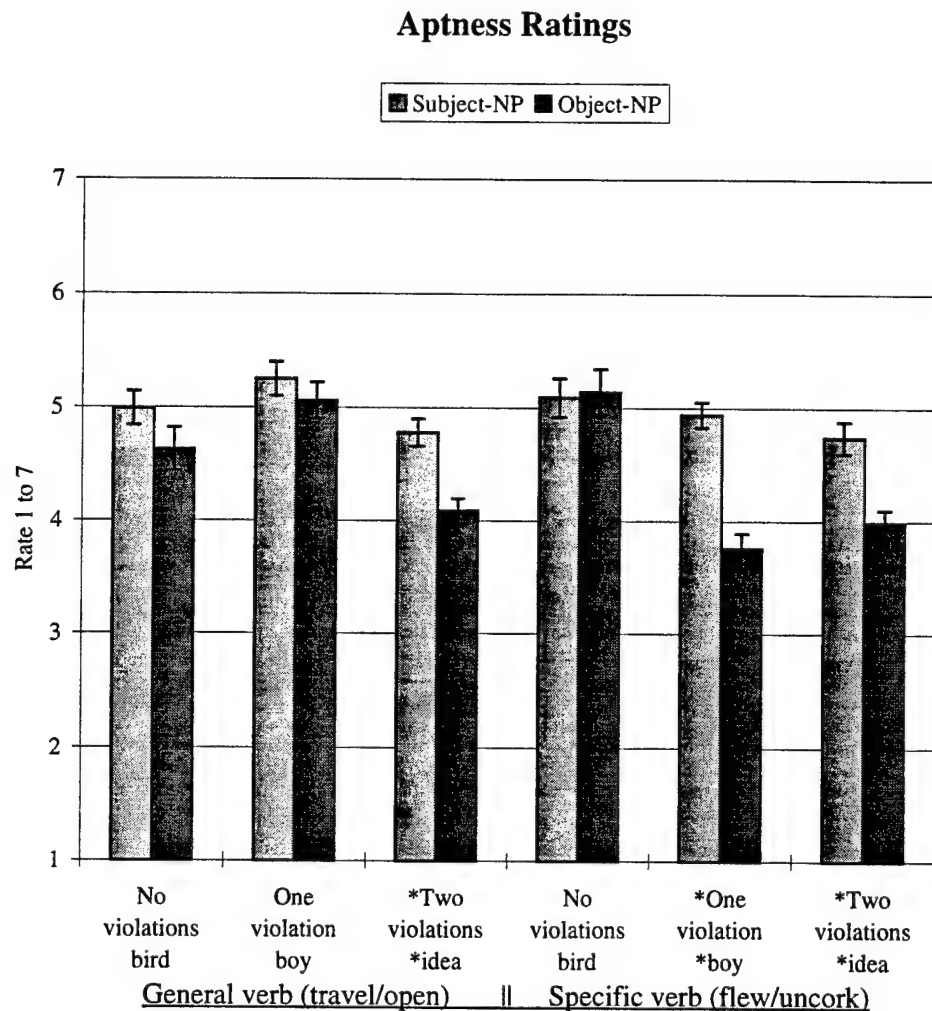
metaphors. No items were excluded based on aptness because no items fell below 2.5 standard deviations from the mean for either violation or no-violation sentences.

Results from 2 Noun-phrase (subject vs. object) x 2 Verb-type (general vs. specific) x 3 Noun-type (violates verbs: none vs. one vs. both) analyses of variance (ANOVA) are reported. Separate analyses were performed with subjects ( $F_s$ ) and items ( $F_i$ ) as random factors. All three variables are within-subjects factors in the subjects analysis, and between-items factors in the items analysis.

The subjects analysis revealed significant main effects for all factors, while the items analysis only revealed significant main effects for Noun-phrase and Noun-type. All two-way interactions were also reliable for the subjects analysis, while the items analysis revealed a significant two-way interaction of Verb-type by Noun-type  $F_i(2, 312) = 9.6, p < .001$ . In addition, there was a significant interaction of Verb-type by Noun-type by Noun-phrase for both the subjects and items analyses  $F_s(2, 58) = 21.46, p < .001$ ;  $F_i(2, 312) = 3.96, p < .05$ .

#### Simple effects analyses

Simple effects analyses were done for both subjects and items analyses to investigate the pattern of results. In short, these analyses showed that sentences with selectional restriction violations, for object noun phrase items, were rated as less apt than sentences in which there were no such violations (see Figure 17).

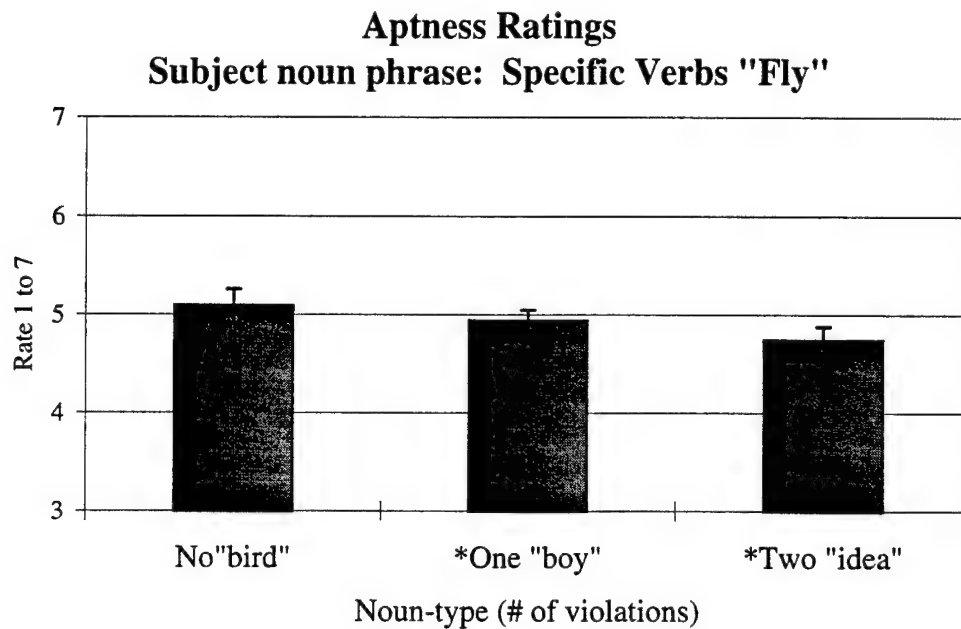


*Figure 17:* Mean aptness rating by sentence type (\*indicates selectional restriction violations).

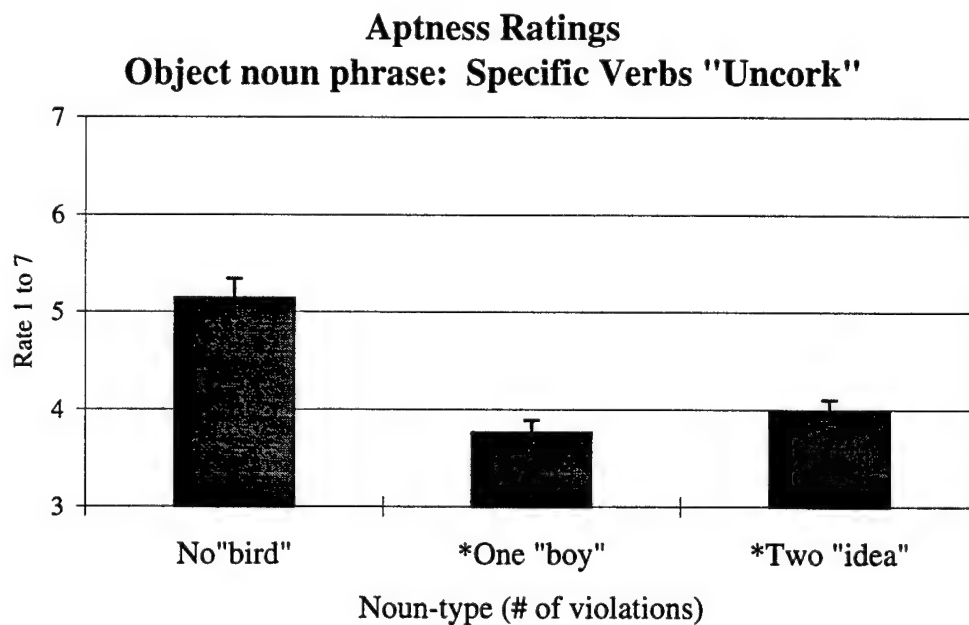
Simple effects treating subjects as random factors investigated the nature of the three-way interaction. The mean aptness ratings as a function of Noun-type, broken down by Noun-phrase and Verb-type levels, are presented in Figures 18-21. The Verb-type by Noun-type interaction was significant for only the object noun phrase sentences. Aptness ratings of all three levels of Noun-type (i.e., no, one, and two violations) differed significantly from each other when used

with a general verb (e.g., open). When used with a specific verb (e.g., uncork), the sentences that did not violate any selectional restrictions (e.g., bird fly/uncork bottle) were judged to be more apt than the sentences in which violations did occur. For the subject noun phrase sentences, there was an effect of noun type. Sentences with nouns that violated only the specific verb (e.g., boy w/either \*flew or travel) were judged to be more apt than sentences with nouns that violated both the general and specific verbs (e.g., idea w/either \*flew or \*travel). Sentences with nouns that did not violate either verb did not differ significantly from either other noun type (see Appendix B for values of all relevant effects).

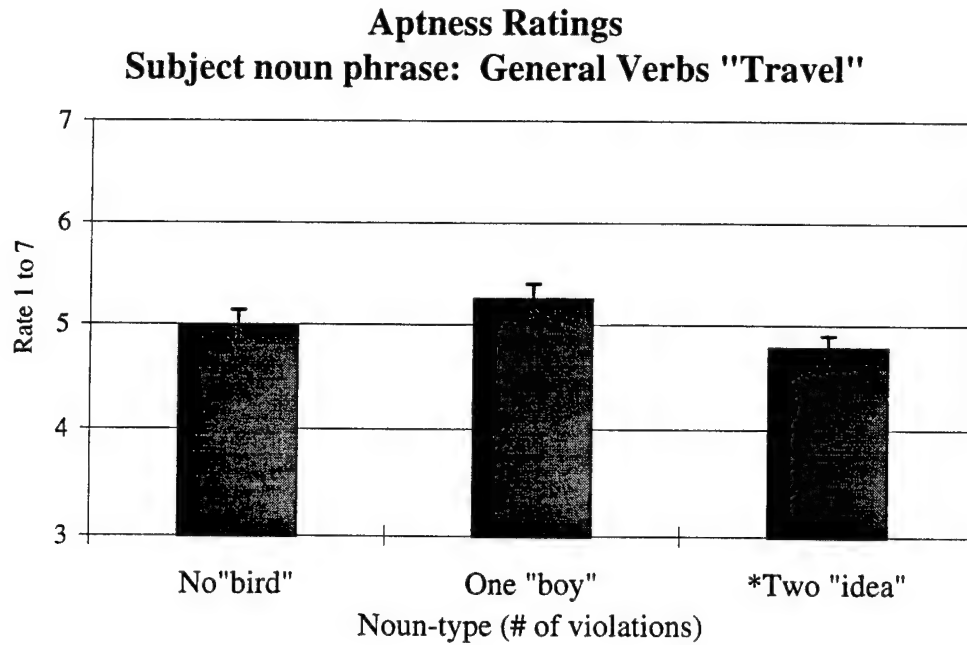
Simple effects treating items as random factors investigated its corresponding three-way interaction. There were no significant differences for the subject noun phrase sentences. There was a significant Verb-type by Noun-type interaction for object noun phrase sentences. For object noun phrase sentences with general verbs (e.g., open), nouns that violated only the specific verb (e.g., gate) were judged to be more apt than sentences with nouns that violated both the general and specific verbs (e.g., thoughts), whereas nouns that did not violate either verb did not differ significantly from either other noun type (e.g., bottle). Object noun phrase sentences with specific verbs (e.g., uncork) revealed the same pattern as in the subjects analysis: the sentences that did not violate any selectional restrictions were judged to be more apt than the sentences in which violations did occur.



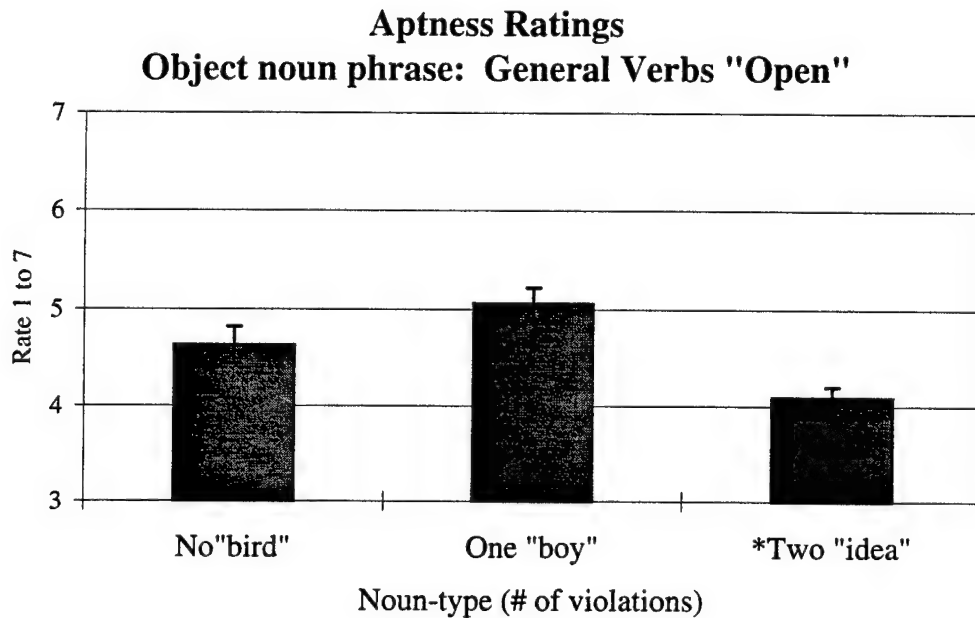
*Figure 18:* Mean aptness rating as a function of Noun-type for subject noun phrase sentences with specific verbs, e.g., "fly" (\*indicates selectional restriction violations).



*Figure 19:* Mean aptness rating as a function of Noun-type for object noun phrase sentences with specific verbs, e.g., "uncork" (\*indicates selectional restriction violations).



*Figure 20:* Mean aptness rating as a function of Noun-type for subject noun phrase sentences with general verbs, e.g., "travel" (\*indicates selectional restriction violations).



*Figure 21:* Mean aptness rating as a function of Noun-type for object noun phrase sentences with general verbs, e.g., "open" (\*indicates selectional restriction violations).

Overall, the subject noun phrase sentences were judged to be more apt than the object noun phrase sentences. In addition, the aptness judgments of the object noun phrase sentences varied according to whether selectional restriction violations occurred. Sentences in which violations occurred were judged less apt than when they did not occur (e.g., uncork gate, uncork thoughts, and open thoughts were less apt than uncork bottle, open bottle, and open gate). This suggests that the quality of the object noun phrase metaphors was not as high as for the subject noun phrase metaphors.

#### Summary

In sum, these data indicate that more complex or selective verbs (e.g., fly/uncork) were judged as more metaphorical than less selective verbs (e.g., travel/open), when used with nouns that violated their selectional restrictions. Furthermore, the degree of metaphoricity was a function of the degree of selectional restriction violation. Comprehensibility and aptness ratings ensured that the predicative metaphors to be used in subsequent tests of the metaphorical use of verbs made sense and were generally apt. In addition, the pattern of results for comprehensibility and metaphoricity mirrored one another. This is consistent with the view that recognition of, or appreciation for, metaphors occurs post-comprehension (Gerrig & Healy, 1983; Miller, 1993).

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## *Chapter 4*

### *Experiment 2*

#### Dual reference in predicative metaphors

Dual reference is a discourse strategy in which the name of a prototypical member of a category is used to name the category itself. Glucksberg and Keysar (1990) claim that in nominal metaphors, the dual reference strategy allows the vehicle term to name a superordinate, ad hoc unlexicalized category to which both the topic and vehicle belong. Thus, a vehicle term can either refer to a literal category instance, or to a generalized superordinate category. For example, the term shark can be used to refer to the general category of vicious, relentless, attacking, etc. things, as in His defense lawyer is a shark. Or the term shark can be used to refer to an instance of the literal category of sharks that are marine animals, as in That hammerhead is a shark. Therefore, in order to comprehend metaphors, people must select the relevant information of the intended ground and ignore irrelevant information. For example, properties of the literal shark referent such as lives in the ocean, are excellent swimmers, has grey leathery skin and fins, etc. are not relevant to understanding His defense lawyer is a shark. Thus, in cases such as metaphor, when the vehicle term is being used to refer to the generalized category, some properties of the literal referent, or category instance, are not relevant.

If dual reference is a mechanism at work in nominal metaphor processing, then there should be evidence of differential property accessibility depending on whether a vehicle term is being used metaphorically or literally. Gernsbacher, Keysar, and Robertson (1995) tested this specific hypothesis using a priming paradigm. They asked participants to judge whether a series of sentences made sense. They presented a list of sentences that alternated between two types of sentences: category assertions and property statements. Embedded within this list were metaphors such as My defense lawyer is a shark and literal counterparts to the metaphors such as That hammerhead is a shark. These sentences were primes for the subsequent property statements, which were either metaphor-relevant or metaphor-irrelevant target sentences. For example, Sharks are vicious expresses a metaphor-relevant property and Sharks are good swimmers expresses a metaphor-irrelevant property. Response times to judge whether sentences made sense were used to measure the accessibility of property information.

Consistent with the dual reference hypothesis, metaphor-relevant target property sentences were responded to more quickly following metaphors than literal counterparts. This suggests that metaphor comprehension makes metaphor-relevant properties more accessible or salient. For example, the property of being vicious is more salient in the case of a lawyer-shark than in the case of a hammerhead shark. In addition, metaphor-irrelevant target sentences were responded to more slowly following metaphors than literal counterparts. This suggests that metaphor comprehension makes metaphor-irrelevant properties less



accessible or salient. Thus, good swimmers is not a property that is accessible after reference to a lawyer-shark. Gernsbacher et al.'s (1995) finding has subsequently been replicated with both younger and older adults (Newsome & Glucksberg, 1996). This differential property accessibility as a function of a metaphorical or literal use of a term supports the claim that metaphor vehicles are used to make dual reference.

Can verbs be used to make dual reference in predicative metaphors? If dual reference plays a role in predicative metaphor comprehension, then verbs can be used to refer at either of two levels of abstraction: to an event that is a literal action category referent, or to a generalized category of events that the verb exemplifies. Therefore, there should be a pattern of property accessibility in predicative metaphors that is strictly analogous to that for nominal metaphors. Experiment 2 was designed to test whether there is evidence of differential accessibility of action-event properties. Such evidence would indicate that verbs can be used to refer to two levels of abstraction in predicative metaphors, supporting the dual reference hypothesis.

The purpose of this experiment was to directly test whether there is any evidence that verbs are used in predicative metaphors similarly to the way nouns are used in nominal metaphors. Specifically, can verbs be used to make dual reference? The priming paradigm used by Gernsbacher et al. (1995) was adapted to test the dual reference hypothesis with predicative metaphors. Predicative metaphors and their literal counterparts replaced the category statements that were

used as prime sentences in the previous studies with nominal metaphors. These prime sentences again alternated with property statements that were metaphor-relevant or metaphor-irrelevant. Thus, sentences in the general form of X verbed (e.g., The idea flew/The bird flew) or X verbed Y (e.g., She uncorked her thoughts/She uncorked the bottle of wine) alternated with property statements in the form of Verbing is/can be some property (e.g., Flying is a fast way to travel/Flying is travelling in the air or Uncorking is revealing/Uncorking permits pouring). If verbs can be used to refer at two levels of abstraction, then metaphor-relevant properties (e.g., Flying is a fast way to travel) should be relatively more accessible after predicative metaphors (e.g., The idea flew) than literal statements (e.g., The bird flew). In addition, metaphor-irrelevant properties (e.g., Flying is travelling in the air) should be relatively less accessible after predicative metaphor comprehension (e.g., The idea flew) than after literal use of the verb (e.g., The bird flew).

## Method

### Participants.

Seventy-two Princeton University undergraduates participated in this experiment: thirty-six were male and thirty-six were female. One participant had previously taken part in the ratings experiment to norm the items used here, and so an additional participant was included to replace her data. Participants were recruited through sign-up sheets that were posted in the Psychology building. All

participants were compensated with credit in a psychology course, with the exception of one person who volunteered her time. All participants were native English speakers and none had previously participated in studies on predicative metaphors.

#### Design and Materials.

A 2 (Noun-phrase) x 2 (Prime) x 2 (Target) mixed factorial was used. All factors are within-Ss factors; Noun-phrase is a between-items factor; Prime and Target are within-items factors. Target sentences, either metaphor-relevant (MR) or metaphor-irrelevant (MI), followed two types of prime sentences. Prime sentences were either predicative metaphors or their literal controls. This results in four types of trials: metaphor primes followed by either metaphor-relevant (MR) or metaphor-irrelevant (MI) property statement target sentences, and literal primes followed by either MR or MI target sentences.

The subset of sentences that were judged to be the most metaphorical in the ratings experiment served as the metaphor items here. Therefore, all of the metaphors were constructed so that two levels of selection restrictions of the verb were violated by the noun. For example, flying is relatively more specific, or informative, about an event than travelling. It describes the manner of travel for an event. Therefore, a noun such as idea, which violates the expectancies or selections of the more general verb travel, necessarily also violates the more specific verb to fly. Thus, sentences such as The idea flew violates the selection for something that can travel, as well as the selection of something that can travel

in the air. Violation of selection restrictions of the verb occurred in either the subject or the object noun phrase of the sentence.

Table 7: Examples of items for priming paradigm in Experiment 2.

SUBJECT noun phrase	
Metaphor	The <u>idea flew</u> across town.
Literal	The <u>bird flew</u> across town.
Relevant	<u>Flying</u> is a fast way to travel.
Irrelevant	<u>Flying</u> is travelling in the air.
OBJECT noun phrase	
Metaphor	He <u>garnished</u> the <u>truth</u> .
Literal	He <u>garnished</u> the <u>meal</u> .
Relevant	<u>Garnishing</u> is exaggerating.
Irrelevant	<u>Garnishing</u> is decorating.

As the examples in Table 7 show, each target sentence started with the progressive form of the verb that was used in the prime sentence. MR targets always referred to properties of the action that were relevant to the ground of the metaphor. MI targets always referred to properties that were not relevant to the ground of the metaphor, but were appropriate to the literal action of the verb, e.g., the in the air sense of the verb to fly.

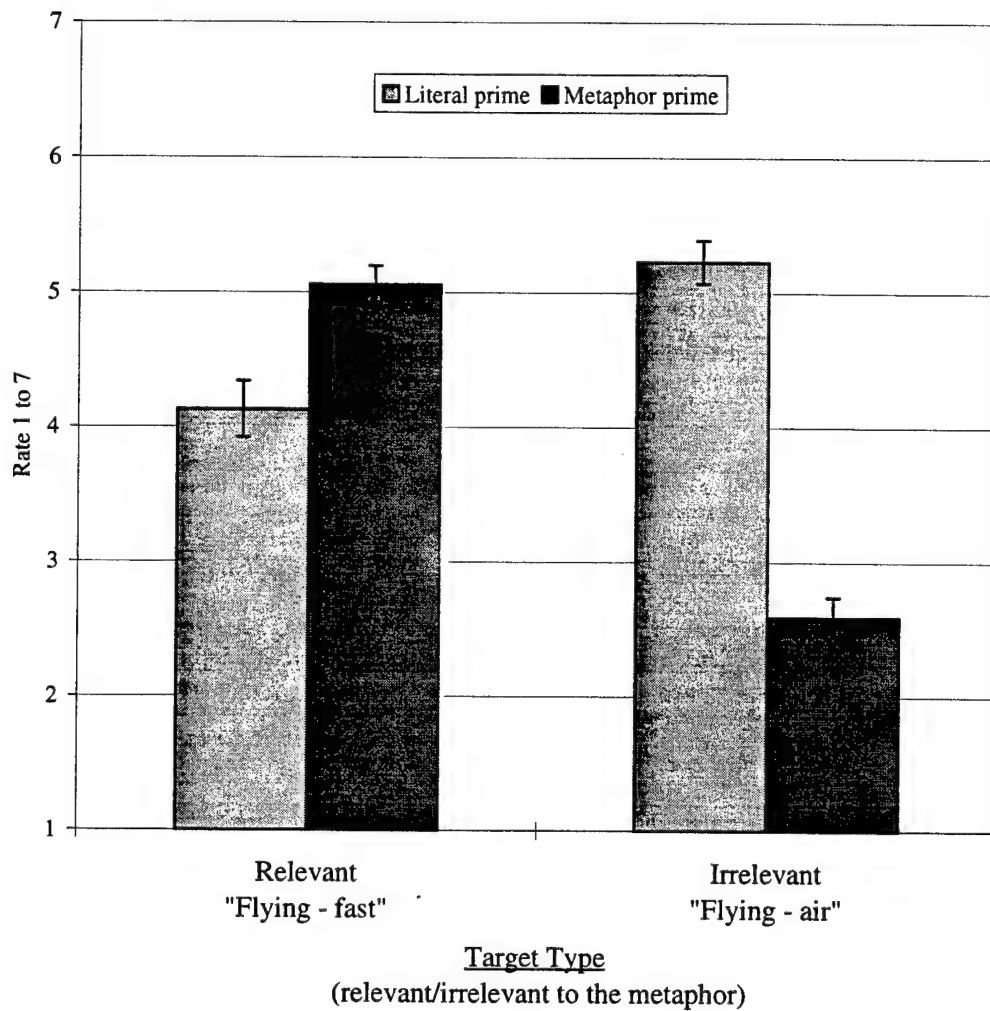
Stimuli norming: Relevance of property statements

Relevance to metaphor ground was determined by a ratings experiment in which thirty-two Princeton University undergraduate students (9 males and 23 females) participated. Prime and target sentence pairs were presented followed by

a scale from 1 (does not at all fit) to 7 (fits extremely well). Participants were instructed to judge “to what extent the statement describing the verb reflects the meaning of the first sentence”. Thus, participants judged to what extent the target property statements describing the verb reflect the meaning of the prime sentences. For example, they rated how well Flying is a fast way to travel or Flying is travelling through the air reflects either The idea flew or The bird flew. The fifty-four sentences (27 subject and 27 object noun phrase) from the first ratings experiment in which a specific verb (e.g., fly/uncork) was used in conjunction with the Two violation noun type (e.g., idea/thoughts) were used in the relevance rating and priming paradigm studies. Items were counterbalanced across four presentation lists using a quasi-Latin square procedure.

Mean ratings as a function of prime type (metaphor or literal) and relevance to the metaphor are presented in Figure 22. A 2 (Prime) x 2 (Target) ANOVA revealed reliable main effects for both factors, as well as a significant interaction  $F(1, 52) = 161.75, p < .001$ . Contrasts revealed that metaphor-relevant properties were judged as a better description of the action of the verbs used in the metaphors than in the literal counterparts  $F(1, 52) = 17.95, p < .001$ . In addition, metaphor-irrelevant properties were judged as fitting the action of the literal statements better than of the metaphors  $F(1, 52) = 182.40, p < .001$ .

### Relevance Ratings of Stimuli for Priming Paradigm



*Figure 22:* Mean rating of relevance of property statements as a function of Prime type (literal vs. metaphor) and Target type (relevant vs. irrelevant to the ground of the metaphor).

The six least desirable items were excluded to yield a total of 48 experimental items. Three items (1 subject and 2 object noun phrase) were excluded based on comprehensibility ratings from the first experiment, mean

ratings 4.05 and below. Three additional items (1 subject and 2 object noun phrase) were excluded as outliers of mean difference scores between MR and MI items for judged fit to the metaphor. This left a total of 25 subject noun phrase and 23 object noun phrase items.

### Priming paradigm

The four prime-target pairs of the 48 experimental items were distributed across four presentation lists with a quasi-Latin square procedure. Participants were randomly assigned to one of the lists. All experimental items required a "yes-yes" response sequence to the makes sense measure. To balance the number of response sequences, 144 pairs of filler sentences were included. Forty-eight of these pairs consisted of anomalous sentences alternating between an X verbed or X verbed Y form and a Verbing is/can be some property form (e.g., Bulbs are only found in bathroom sinks / Finding can be cleaning bath tubs), thus requiring 48 "no-no" response sequences. Twenty-four pairs of a sensible metaphor followed by an anomalous property statement elicited 24 "yes-no" response sequences (e.g., The squeaky violin cried as the youngster played it / Crying is throwing footballs). Twenty-four pairs of sensible literal sentences followed by an anomalous property statement resulted in 24 "yes-no" response sequences (e.g., That paper certifies the jewelry's authenticity / Certifying is a baking requirement). Finally, 48 pairs of anomalous sentences followed by a sensible property statement required 48 "no-yes" response sequences (e.g., He tricked his

shoestring with magic / Tricking can be deceitful). These filler sentence pairs were cannibalized from materials provided by Gernsbacher et al. (1995), and are shown in Appendix A along with the experimental items.

Within each list, trials were blocked in order to give participants two chances to rest their eyes throughout the experiment. Experimental items were quasi-randomly distributed to three sets so as to maintain an equal number of the four trial types (metaphor/literal prime sentences followed by metaphor-relevant /metaphor-irrelevant target property statements), and as far as possible of subject and object noun phrase items, per set. In addition, the four types of filler pairs were equally represented in each set. Therefore 16 experimental and 48 filler trials were in each block. These sets were presented in different block orders across the four presentation lists. A different randomized order of trials within each block was presented for each participant.

#### Procedure.

Participants were informed that the experiment concerned how people understand figurative language, such as metaphor, and that they would be asked to read a list of sentences and to decide whether or not they make sense. Each participant was tested individually and randomly assigned to receive one of the four presentation lists. They were told that they would read sentences one at a time on a computer screen and decide whether or not each one made sense. Once seated at the computer, participants read detailed instructions that provided examples of sentences that did and did not make sense. In addition, they were



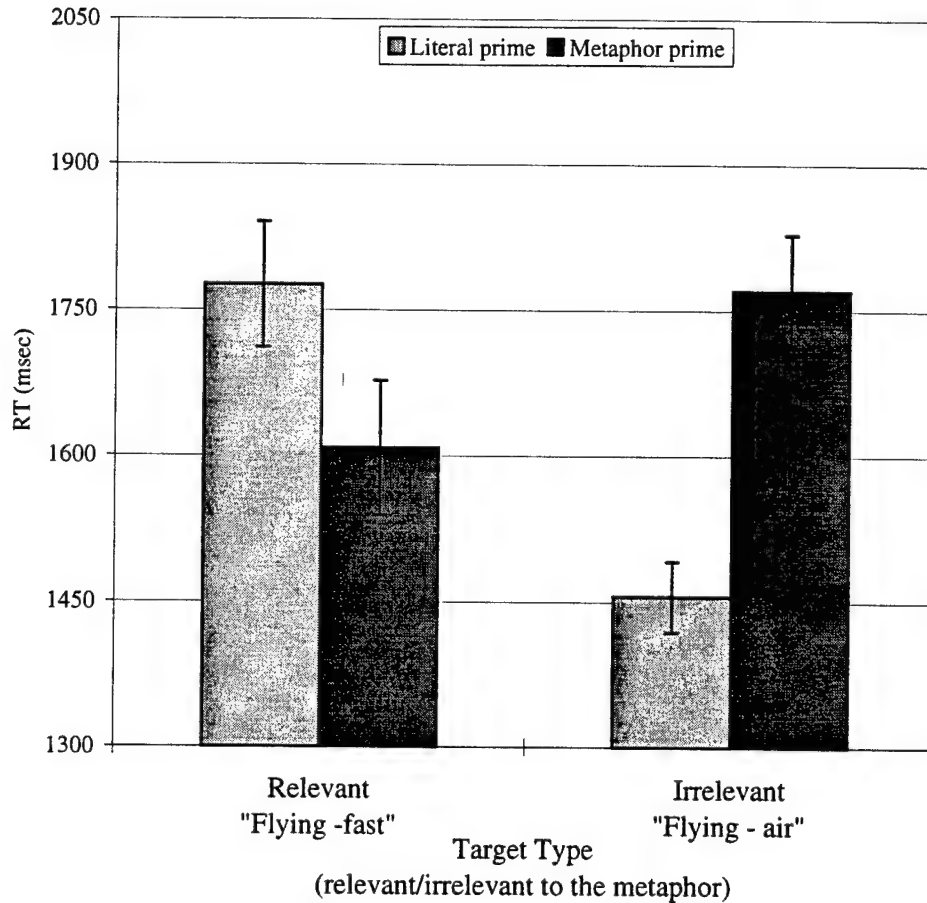
provided with eight prime and target practice trials with feedback on accuracy after each trial. If the participants had no questions after reading through the instructions and completing the practice trials, they were allowed to proceed with the experiment. Response times and accuracy for the sensibility judgments were measured. On average, each participant took approximately 20 to 40 minutes to complete the experiment; range of completion time may have varied according to participants' use of the two chances to rest their eyes throughout the experiment.

### Results and Discussion

The data analyses were conducted using only those experimental trials in which both prime and target sentences were judged as making sense. Results from 2 (Noun phrase) x 2 (Prime) x 2 (Target) analyses of variance (ANOVA) are reported treating both subjects (Fs) and items (Fi) as random factors. All three variables are within-subjects factors in the subjects analysis. In the items analysis, Noun-phrase is a between-items factor, while both prime and target are repeated factors.

Mean response times as a function of condition are presented in Figure 23. The data of interest are the response times to metaphor-relevant and metaphor-irrelevant property statements as a function of prime type. As with nominal metaphors, there was a reliable interaction of prime and target type  $F_s(1, 67) = 24.38, p < .001$ ;  $F_i(1, 42) = 6.09, p < .05$ .

### Priming Paradigm: Dual Reference



**Figure 23:** Mean response time (msec) in priming paradigm for the “makes sense” judgment as a function of Prime type (literal vs. metaphor) and Target type (relevant vs. irrelevant to the ground of the metaphor).

Responses to metaphor-relevant property statements were faster when they were preceded by predicative metaphors (1603.20 msec) than when preceded by literal control sentences (1762.81 msec). This indicates an enhancement of salient metaphor ground-related properties as a result of predicative metaphor

comprehension. For example, properties such as fast travel are relatively more accessible after reference to ideas flying than after reference to birds flying. Responses to metaphor-irrelevant property statements were slower after predicative metaphors (1711.47 msec) than after literal control sentences (1467.22 msec). This suggests that the process of understanding predicative metaphors results in metaphor-irrelevant properties becoming less accessible or salient. For example, air travel is not a property that is accessible after reference to ideas flying, relative to reference to birds flying. These results replicate those found with nominal metaphor processing by Gernsbacher et al. (1995) and Newsome and Glucksberg (1996).

These data provide evidence of differential accessibility of action-event properties. This indicates that verbs can be used to refer at two levels of abstraction in predicative metaphors. Verbs can be used to refer to an event belonging to a literal action category, such as using flying to refer to travelling through the air. Verbs can also be used to refer to an event belonging to a generalized action category that the literal action referent exemplifies, such as using flying to refer to fast, direct, etc. travel. This is consistent with the hypothesis that dual reference plays a role in predicative metaphor comprehension, lending credence to the idea that verbs are used in predicative metaphors analogous to the way nouns are used in nominal metaphors.

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## Chapter 5

### *General Discussion*

In an attempt to expand the present scope of theories and research on metaphor use and comprehension, the studies reported here focus on the metaphorical use of verbs. Two general questions were initially posed: a) how are predicative metaphors understood?, and b) how do we recognize when a figurative meaning is intended? To address these questions, theories of nominal metaphor processing were assessed.

Similarity comparison models treat nominal metaphors as implicit similes. According to this approach, matches between properties in the topic and vehicle serve as the ground for the metaphor. Those features are selected by salience imbalance, according to Ortony (1979), or relational structural alignment, according to Gentner (1983). Miller (1993) argues that when verbs are used metaphorically the first step in processing the metaphor is to reconstruct the predicate or sentential concepts so that they are understood conceptually as a comparison. From there, similarity processes determine the ground.

Comparison based models of nominal metaphor comprehension fail to account for cases in which the listener, or reader, has no prior specific knowledge of the topic. In addition, if specific knowledge of the topic is represented, then the utterance is uninformative according to discourse principles. This failure also

applies to any account that attempts to explain predicative metaphors by similarity processes. The listener or reader does not always have specific knowledge of both predicate terms being compared. Once again, if specific knowledge is represented, then the utterance is uninformative. Therefore, similarity comparison cannot explain either how metaphors are comprehended, nor what distinguishes metaphoric from literal comparisons. As a result, comparison processes are rejected as a plausible account for predicative metaphor processing.

The interactive-attributive approach does not suffer the weaknesses of comparison models. This view does not rely upon specific properties, relevant to the ground of the metaphor, to be in the representation of the topic a priori. Although general knowledge of the topic is necessary to identify what would be informative about the topic, specific values along those relevant dimensions are not represented a priori. Instead, properties of the vehicle are attributed to the topic, providing specific values along relevant dimensions of the topic. Therefore, the interactive-attributive approach was taken as the preferred foundation for an account of predicative metaphor processing.

How are nominal metaphors comprehended and what distinguishes a figurative from a literally intended meaning? According to Glucksberg and Keysar (1990; see also Glucksberg, et al., 1997), general cognitive processes and discourse strategies account for both problems. In metaphors of the form "X is a Y", the topic (X) and vehicle (Y) jointly determine the category to which they both belong. The vehicle term is borrowed to name this superordinate, ad-hoc,

non-lexicalized category. Thus, the vehicle term can be used to make dual reference: either to the literal referent or to the superordinate, generalized category referent. The vehicle and topic play different and interacting roles in determining the ground of the metaphor. Topics provide the relevant dimensions for attribution and vehicles provide properties along those dimensions to be attributed to the topic. Metaphoric and literal class-inclusion utterances can be distinguished, and appreciated, after comprehension. Recognition of nominal metaphors results from the combination of the surface category violation and the use of the dual reference strategy to name the newly formed ad hoc superordinate category. Thus, the dual reference strategy plays a role in answering both initial questions.

Since dual reference is connected to both basic problems of comprehension and recognition, the studies on predicative metaphor processing presented here focused on investigating whether verbs can be used to make dual reference. One indication that nouns are being used figuratively is that metaphoric comparisons can be stated in either a class-inclusion form (i.e., is a) or in a comparison form (i.e., is like a) without substantially altering the meaning, whereas literal comparisons cannot be rephrased in this manner. This is possible because the vehicle term can be used to refer to either of two levels of abstraction: the literal referent and the ad hoc category referent. Although predicative metaphors do not take the form of class-inclusion utterances that present literal category violations, there seems to be an analogous indication that verbs are being

used figuratively. Sentences in which nouns and verbs are mismatched, or the verb's selectional restrictions are violated, can be hedged (e.g., it was as if) in a way that literal utterances cannot be rephrased. For example, weakening the claim that The boy flew across town with it was as if he flew does not suggest an appreciably changed intended meaning. Whereas to hedge The bird flew across town in the same way does appear to alter the intended meaning. This indicator suggests that dual reference is being used in predicative metaphors. Just as vehicle terms are used in nominal metaphors to point to a category in which no membership violation occurs (e.g., both jobs and jails can belong to the ad hoc category of things that are unpleasant, restrictive, etc.), verbs may be used in predicative metaphors to point to an action, or event, in which no selectional restriction violations occur (e.g., flying used to refer to the category of fast, direct, etc. movement, rather than to travelling in the air).

The goal of Experiment 1 was to investigate whether selection restriction violations influence metaphoricity judgments, thereby serving as a potential cue to metaphoricity. Ratings of predicative metaphors (e.g., The car flew across the intersection) suggest that verbs are interpreted metaphorically when their selection restrictions are violated. For example, the verb to fly normally (literally) takes subjects that are capable of air travel, such as birds or airplanes. When this restriction is violated, (e.g., cars or ideas flying), the verb is interpreted as being used metaphorically. Furthermore, the degree of metaphoricity is a function of the degree of violation. This result parallels Gentner and France's (1988) finding

that the degree of meaning change in paraphrase tasks reflects the degree of semantic strain between noun and verb.

In addition, when the selection restrictions of verbs are violated, the metaphors are judged to be less comprehensible. Thus, comprehensibility and metaphoricity judgments mirror one another. This pattern of data is consistent with metaphoric and literal uses of verbs being distinguished, and appreciated, after comprehension (Gerrig & Healy, 1983; Miller, 1993). Thus, after comprehending a sentence in which a selectional restriction violation occurs, participants can rely upon the degree of that violation to judge the degree of metaphoricity of the sentence. Therefore, similarly to nominal metaphors, this suggests that recognition of predicative metaphors may result from the combination of the surface selection restriction violation and comprehension processes.

Does this necessarily mean that the more the verb is "bent", the more difficult the comprehension? These data suggest this is a possibility. If in fact comprehension is necessarily a function of metaphoricity, this would distinguish predicative metaphors from nominal metaphors. Nominal metaphors need not be more difficult to understand than comparable literal expressions. However, these data are inconclusive. First, participants did not make judgments as to ease of comprehension for the literal counterparts of the predicative metaphors (e.g., The idea flew across town vs. The idea spread quickly, etc.). Second, it is possible that a rating task may not be sensitive to the comprehension process, per se. For



example, measuring comprehension response times might reveal little difference between sentences in which a selectional restriction violation occurs and sentences in which they do not. Finally, these metaphors were judged independent of context. Rather than comprehensibility being a function of metaphoricity for predicative metaphors, it is possible that metaphorical verb use requires more supporting context than nominal metaphors.

Experiment 2 sought evidence for verbs making dual reference in predicative metaphors. A priming paradigm, previously used to investigate nominal metaphor processing, was used to assess whether there is differential accessibility of properties of action-events. The results indicate that verbs can be used to make dual reference. The same pattern that is found for nominal metaphor processing occurs with predicative metaphor processing. Response times to whether sentences made sense indicated that uses of a verb in different contexts results in differential property accessibility. Properties of the literal action referent (e.g., flying is travelling in the air) are less accessible after a metaphorical use of a verb, i.e., cases in which selection restrictions are violated, than after literal uses of a verb, i.e., cases in which violations do not occur. In addition, properties associated with the ground of the metaphor (e.g., flying is fast) were more accessible after a metaphorical use of a verb than after a literal use. This differential property accessibility suggests that verbs can be used to make dual reference. In a literal context (e.g., The bird flew) in which no selectional restrictions are violated, flew refers to a literal action category of

moving through the air. In a metaphorical context (e.g., The idea flew) in which selectional restrictions are violated, flew refers to a generalized superordinate category of actions that are fast and direct. Evidence of dual reference playing a role in predicative metaphors suggests that the interactive-attributive approach is promising.

These studies are initial steps towards answering how predicative metaphors are comprehended. However, how the interpretation process is constrained has not been directly addressed. Are there corollaries for other aspects of the interactive-attributive model (Glucksberg & Keysar, 1990; Glucksberg, et al., 1997) that apply to predicative metaphors? For example, dual reference implies two things: a) that a superordinate category is being referred to, and b) that the name for that category is a prototypical example of that category. How that category is determined and whether, in fact, verbs that are prototypical exemplars of such categories serve as better labels than other category members remain to be investigated. In addition, the interactive-attributive model specifies the different roles that the topic and vehicle play in constraining the interpretation of nominal metaphors. What is selected as relevant in predicative metaphors, and how?

How can a category-based comprehension process, such as the interactive-attributive view of nominal metaphors, account for sentential comprehension in which there are no class-inclusion assertions? As Miller (1993) described, functions can take either one or two arguments. Sentences with intransitive verbs,

such as The bird flew, are examples of single argument functions and they can be expressed by the general form  $F(x)$ . In this case, flew is the function that maps an argument that can travel in the air, such as the bird, and can be expressed as  $FLEW(\text{the bird})$ . Functions with single arguments, like this, are said to express properties of the argument (i.e., flying is a property attributed to or predicated of the bird). Sentences with transitive verbs, such as He uncorked the bottle, are examples of concepts with two arguments that can be expressed by the general form  $F(x, y)$ . In this case, the arguments he and the bottle are related by uncorking. Thus two argument functions, such as  $UNCORK(\text{he}, \text{bottle})$ , express relations between those arguments. However, Miller also notes that relations can be treated as properties. That is, sometimes a concept expressed by a sentence such as He uncorked the bottle can be taken as a case in which uncorking bottles is a property attributed to he. Two argument functions can be expressed as single argument functions, thereby being conceptualized as expressing properties of the argument:  $UNCORK(\text{he}, \text{bottle})$  is conceptualized as  $UNCORK\ BOTTLE(\text{he})$ . Thus, predication can be described as a process of attributing action properties to arguments. Therefore, an attributive account of predicative metaphors seems highly plausible.

Miller (1993) argues that all metaphors, not just nominal metaphors, are understood as similarity comparisons. Miller represents the general form of all similarity comparisons as:

(1) SIM [F(x), G(y)]

This expresses that some properties of x and some properties of y are shared, but one concept does not entail the other. The notation SIM represents the similarity relation between concepts, and both F and G stand for functions that take arguments x and y, respectively. The function F indicates the referent (i.e., the topic, X, or subject, A, term) and the function G indicates the relatum (i.e., the vehicle, Y, or predicate, B, term). For example, the sentential concept The brain works the way a machine computes would be expressed as SIM [WORK(the brain), COMPUTE(a machine)]. When the specific properties of a comparison are not supplied in the sentential concept, as in The brain is like a computer, Miller claims it is conceptually understood as "some properties of the brain are like some properties of a machine" which can be expressed as:

(2)  $(\exists F) (\exists G) [SIM [F(\text{the brain}), G(\text{a machine})]]$ .

Since according to Miller, all metaphors are similarity comparisons, reconstructing a concept into this comparison form is crucial to metaphor understanding. Therefore, The brain is a computer is understood in the same way as the above comparison statement.

Miller (1993) claims this same process of reconstructing a similarity comparison occurs in more complicated cases in which simply replacing is with is like will not always work. This is the case when the terms of the comparison statement are clauses or sentences, such as in predicative metaphors. This is possible because, as noted above, relations can be treated as properties. For

example, He uncorked her thoughts would be, according to Miller, reconstructed conceptually as SIM [F(he, her thoughts), UNCORK(y, y')]. This expresses the concept that the relation between the he and her thoughts is similar to something uncorking something. The primary task of interpreting metaphors is to find fitting values for the missing arguments (e.g., the values of F, y, and y') that are identified by the reconstruction step.

The missing properties are understood as anything that can be attributable to both the referent (i.e., the subject) and the relatum (i.e., the predicate). In Miller's examples, John is eating (e.g., EAT(John, y); John eats something) involves conventional constraints, in that the missing argument is understood to be something edible. The nominal metaphor John is a wolf (e.g., SIM [F(John), G(wolf)]; some properties of John are like some properties of wolves), however, does not have conventional constraints so the process of understanding the missing elements is to determine any properties that can be attributable to both wolves and John. The interactive-attributive view (Glucksberg & Keysar, 1990; Glucksberg, et al., 1997) offers the processes by which such properties that are attributable to both wolves and John are determined: categorization and dual reference.

Miller (1993) describes the interpretation of predicative metaphors in the same manner as for nominal metaphors. A predicative metaphor such as The boy flew, with the conceptual structure G(x)(i.e., FLY(the boy)), where G (i.e., FLY) is something that is not normally predicated of x (i.e., the idea; ideas don't

normally fly) would be reconstructed and conceptually understood as  $(\exists F)(\exists FLY)\{SIM[F(\text{the boy}), FLY(y)]\}$ . Thus, some property of boy is like something flying or something that flies. "Finding appropriate classes of referents and relata is, strictly speaking, part of the task of interpretation." (Miller, 1993, p. 393). In the case of predicative metaphors, the degrees of freedom are in choosing, selecting, or identifying both F and y.

In selecting y, Miller suggests that it is often enough to consider whatever is the most generic argument of G: what is typically predicated by G? For example, if the metaphor concept is FLY(x) then there would be a search for something such that FLY(y) is highly predictable. Thus, some property of boy is like something that typically flies, e.g., y could be a bird or an airplane. This can be understood as saying that x is one of the generic class of things that FLY can be predicated of. Therefore, FLEW(the bird), (i.e., the G(y) concept), tells us that bird is one of a class of things that FLY can be predicated of; FLEW(the boy) (i.e., the term F(the boy)), places boy in that class of things that fly. Miller states that

If you were to ask what features to transfer from y to x, I would answer, "Whatever features are necessary in order to include x in the class of things that G is commonly predicated of." ...the reinterpretation of x as a kind of y is part, and sometimes the most important part, of interpreting the metaphor (Miller, 1993, p.393).

Ironically, then, although Miller argues that all metaphors are understood via similarity comparison processes, the interpretation phase of the comprehension process reflects an interactive-attributive approach.

Miller (1993) claims that a more difficult task involves searching for the missing value of F that fits the appropriate relation between x and G (e.g., in SIM [F(the boy), FLY(y)]. That is, what property does the boy have (or what does the boy do) that reflects the relation between boy and flying? Miller suggests that the strategy of asking what function is commonly predicated of x (e.g., what are typical properties of the boy or what do boys typically do?) would probably not be as successful as the similar strategy suggested to determine typical arguments of G (e.g., what typically flies?) in order to discover y. This strategy is not likely to be as successful here because there are many cases in which nothing makes itself as a clear choice as primary predicate of the argument. Nothing stands out as the property of boy that suggests the relation between boy and flying. Therefore, he suggests (referring to Reinhart, 1976) that the search for F is probably constrained by G: the search for the relevant property of boy is constrained by the concept FLYING.

...the effect of F should be to delete certain semantic features of G - that G should be allowed to stand as the function applied to x, but that only those semantic features of G that are compatible with F are to be effective (Miller, 1993, p.394).

Thus, FLY should be applied to x (the boy), but only semantic features of FLY that are compatible with the boy will be attributed.

The problem becomes which semantic features should be deleted from the concept fly and which ones should be attributed to the boy? For example, flying in the air is not compatible; whereas movement, in that flying is one type of

movement, is compatible. Thus, selectional restriction violations suggest themselves as one constraint in determining the properties which are selected to be attributed to the argument. Specifically, they may help to guide an interactive contribution of the noun and verb in determining the ground. As previously described, as verbs become more specific, the information that they convey increases. In addition, the restrictions on the type of nouns that the verb can accept consequently increase. The interactive-attributive approach suggests analogs from the interacting roles of topic and vehicles in nominal metaphors to determine the grounds of predicative metaphors. The noun can contribute information regarding the types of actions with which it is compatible, as well as what would be informative about the argument. The verb can contribute the values along those dimensions of potential actions, as well as label the more general category of events that the noun and verb create. The verb will be a better label of this category if it is a prototypical member of that category. For example, if fly is a good example of fast travel it is more likely to be able to refer to that category.

Indeed, this characterization of the interactive-attributive approach applied to predicative metaphors warrants investigation. Some evidence suggests this route would be fruitful. Gentner and France (1988) report that when sentences are constructed so that there is semantic strain between the verb and the noun (e.g., The lizard worshipped), it is the meaning of the verb, rather than the noun, that is altered during interpretation. Moreover, some parts of the verb's meaning are



more resistant to change than others. Specifically, domain-specific features are the first to change in meaning. They report that verbs that normally convey a causal change of possession, such as discard, were interpreted as a causal change in some other dimension. For example, paraphrases of Marvin discarded a doctor (e.g., Marvin consulted a different practitioner of medicine) still reflected a causal change of state, although the notion of ownership was lost. Thus, people's interpretations reflect a minimal change in verb meaning. This supports the idea that selectional restrictions may be one cue indicating the selection of properties for interpretation. The more specific, or constraining, selectional restrictions may be altered first.

In addition, McRae, Feretti, and Amyote (in press) provide evidence that action categories are jointly defined by the noun and verb. Specifically, they report ratings of typicality for thematic roles: good agents (e.g., subjects of a verb) and good patients (e.g., objects of a verb) of verbs. For example, a cop is a highly typical agent that arrests someone, or it may be very typical to terrorize a victim. This lends credence to the strategies suggested by Miller (1993) to search for the missing values of predicative metaphors (e.g., what typically flies?).

It is important that the contributions that nouns and verbs make in predicative metaphors be investigated. It seems likely that there will be different categories of types of information contributed by nouns and verbs, just as there are high and low constraining topics or ambiguous or unambiguous vehicles in nominal metaphors (Manfredi & Glucksberg, 1994). For example, Miller (1993)

suggests that the strategy of asking what function is commonly predicated of *x* is not likely to be successful. Thus, asking about the properties of boy for The boy flew across town is not likely to be successful because there are no properties of boy that stand out as that suggesting a relation between boy and flying. This seems reasonable. However, is it always the case that there is nothing that stands out as chief predicate applied to the argument *x*? It seems there are cases in which properties of the argument would be salient. For example, in The bell cried from the tower, ring is something that stands out to be predicated of the bell. In addition, although it may be typical for the verb's meaning to be the locus of meaning change when there is semantic strain (Gentner & France, 1988), it is not necessarily so. For example, in John married his work a likely interpretation of John is committed and dedicated to his work does suggest that it is the meaning of the verb married that is being extended. However, in John is married to a gem it seems more likely that gem would be interpreted as referring to the type of partner to whom John is married; gem is altered rather than married in this case (Miller, 1993). No relationship between people and precious stones warrant comment. Thus, nouns and verbs may contribute different and interacting information to determine the ground of predicative metaphors.

It is suggested here that selectional restriction violations could possibly guide the constraints contributed by nouns and verbs in predicative metaphor processing. In addition, the data presented here suggest that selectional restriction violations are a cue to metaphoricity. However, it should be noted that selectional

restriction violations are neither necessary nor sufficient to claim an utterance was intended figuratively. Context plays an important role in constraining the interpretation process. As is the case when nouns are used metaphorically, the broader context also guides selection of dimensions and properties that are relevant to the situation. For example, the broader context of memory or size would influence what is likely to be taken as the ground of George is an elephant. Similarly, The boy jumped on his bike and flew across town, which violates literal selection restrictions would be taken literally in a magical movie context such as E.T. or Mary Poppins where, in fact, it is possible for people on bikes to be travelling in the air. In addition, a sentence such as The bird flew around the room uttered in the context of referring to a social butterfly at a party suggests that utterances without selectional restriction violations can be intended figuratively. Ultimately, what would be informative to the situation in which the utterance occurs will influence the interpretation process.

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## Appendix A

### Stimuli for Experiment 1: Ratings of predicative metaphors

Six-sentence item sets are listed by whether the selectional restriction violation occurs with the subject noun phrase or the object noun phrase of the sentences for that set. Sets are presented by noun type, which indicates pattern of selectional restriction violations when used with specific or general verbs (i.e., in order of No, One, and Two violations). Note that L (i.e., literal) is used to label the cases in which selectional restrictions are not violated and M (i.e., metaphorical) is used to label the cases in which selectional restriction violations do occur.

<u>Noun type</u>	<u>Specific verb / General verb</u>	
No violations	LL	literal / literal
One violation	ML	metaphorical / literal
Two violations	MM	metaphorical / metaphorical

#### Subject noun phrase violations:

1.  
LL The bird grabbed the worm and **flew / went** across town.  
ML The boy grabbed his bike and **flew / went** across town.  
MM The idea **flew / went** across town.
2.  
LL Margaret's knitted sweater **unravelled / fell apart** during her vacation.  
ML Margaret's ancient car **unravelled / fell apart** during her vacation.  
MM Margaret's careful plan **unravelled / fell apart** during her vacation.
3.  
LL As the ocean storm's intensity increased, Patrick's ropes **frayed / wore\_out**.  
ML As the ocean storm's intensity increased, Patrick's boat engine **frayed / wore\_out**.  
MM As the ocean storm's intensity increased, Patrick's nerves **frayed / wore\_out**.



4.  
LL The barber-shop quartet is **whistling / moving** toward center stage.  
ML The galaxies are **whistling / moving** toward a common center.  
MM Political opinion is **whistling / moving** toward a common center.
5.  
LL Sara's worn down nanny **limped / traveled** back home.  
ML Sara's worn down station wagon **limped / traveled** back home.  
MM Sara's worn down confidence **limped / traveled** to new depths.
6.  
LL The children **danced / moved** over the full extent of the stage.  
ML The boats **danced / moved** along the full extent of the shore.  
MM The paint **danced / moved** over the full extent of the canvas.
7.  
LL Droplets **rained / fell** on every inch of the arena.  
ML Confetti **rained / fell** on every inch of the arena.  
MM Sound **rained / fell** on every inch of the arena.
8.  
LL The hurricane **stormed / forced** its way through the coastal defenses.  
ML The troops **stormed / forced** their way through the opposing defenses.  
MM Lisa's verbal assault **stormed / forced** its way through his emotional defenses.
9.  
LL The storm clouds **hovered / hung** over the village.  
ML The poster **hovered / hung** over the desk.  
MM John **hovered / hung** on her every opinion.
10.  
LL The toddler **crawled / climbed** up the steep slope.  
ML The semi **crawled / climbed** up the steep slope.  
MM Their despair **crawled / climbed** up to a peak.
11.  
LL The black bear was **slumbering / idling** on the side of the road.  
ML The RV was **slumbering / idling** on the side of the road.  
MM His energy was **slumbering / idling** at a most inopportune time.

12.  
LL The club bouncer **lumbered / traveled** towards town.  
ML The bulldozer **lumbered / traveled** towards town.  
MM The bad news **lumbered / traveled** towards town.
13.  
LL The little girl **tiptoed / moved** along the trail.  
ML The mountain bike **tiptoed / moved** along the trail.  
MM The autumn leaves **tiptoed / moved** along the trail.
14.  
LL The raccoons **ate / consumed** the debris of the fair.  
ML The garbage truck **ate / consumed** the debris of the fair.  
MM Mark's subconscious **ate / consumed** his emotional debris.
15.  
LL The water **streamed / ran** through the forest.  
ML The marathoners **streamed / ran** through the streets.  
MM The words **streamed / ran** through her head.
16.  
LL The punkers **pushed / displaced** other concert goers off of the platform.  
ML O.J.'s trial **pushed / displaced** all other stories from the front page.  
MM Thoughts of food **pushed / displaced** all other thoughts from his mind.
17.  
LL The commuters **shivered / shook** in the harsh wind.  
ML The building **shivered / shook** in the earthquake's harsh aftershocks.  
MM Justice **shivered / shook** at the O.J. verdict.
18.  
LL The tap dancer **danced / beat** rhythmically on the stage floor.  
ML The waves **danced / beat** rhythmically on the shore .  
MM The moonlight **danced / beat** rhythmically on the shore
19.  
LL The bees **swarmed / gathered** on the honeycomb.  
ML The clouds **swarmed / gathered** on the horizon.  
MM The colors **swarmed / gathered** on the mural.

20.  
LL The neighbors **obeyed / adapted** (to) the constraints of the property.  
ML The plants **obeyed / adapted** (to) the constraints of the garden.  
MM The treaty **obeyed / adapted** (to) the constraints of their demands.
21.  
LL The balloons **inflated / grew** into unusual shapes.  
ML His waistline **inflated / grew** no matter what he did.  
MM Her courage **inflated / grew** to meet the challenge.
22.  
LL The rock climbers **climbed / rose** to the mountain ridge.  
ML The sourdough **climbed / rose** to perfection  
MM Inflation **climbed / rose** to new heights.
23.  
LL The dog **howled / expressed** (his need) for attention  
ML The child **howled / expressed** (his need) for attention.  
MM The vegetable garden **howled / expressed** (its need) for attention.
24.  
LL The tuna were **floundering / trying** to escape from the fisherman's net.  
ML Julie was **floundering / trying** to provide for her children while on welfare.  
MM Julie's thoughts were **floundering / trying** to fit together in class.
25.  
LL The entire harvest **wilted / decayed** over time.  
ML The Victorian house **wilted / decayed** over time.  
MM The town vagabond's sanity **wilted / decayed** over time.
26.  
LL The little girl **kissed / touched** the bouquet of flowers.  
ML The rain **kissed / touched** the bouquet of flowers.  
MM The sunshine **kissed / touched** the bouquet of flowers.
27.  
LL The virus **infected / contaminated** the nuclear plant workers.  
ML The toxic waste **infected / contaminated** the nuclear plant workers.  
MM The rumor **infected / contaminated** the nuclear plant workers.

Object noun phrase violations:

1.  
LL The young man **kidnapped** / **stole** the child that wandered from the group.  
ML The young executive **kidnapped** / **stole** the opposition's solution.  
MM The young lover **kidnapped** / **stole** the moon for the evening.
2.  
LL The woman **killed** / **rejected** the prize winning hog.  
ML The woman **killed** / **rejected** the proposal.  
MM The woman **killed** / **rejected** her desires.
3.  
LL Before it was too late, Brian **holstered** / **restrained** his weapon.  
ML Before it was too late, Brian **holstered** / **restrained** his tongue.  
MM Before it was too late, Brian **holstered** / **restrained** his pain.
4.  
LL Jen **filed** / **saved** her official letters.  
ML Jen **filed** / **saved** her money.  
MM Jen **filed** / **saved** her anger.
5.  
LL Matt **unlocked** / **opened** his door.  
ML Matt **unlocked** / **opened** his old wound.  
MM Matt **unlocked** / **opened** her heart.
6.  
LL Melissa **uncorked** / **opened** the bottle of wine.  
ML Melissa **uncorked** / **opened** the starting gate.  
MM Melissa **uncorked** / **opened** her thoughts.
7.  
LL They **unleashed** / **released** the dogs.  
ML They **unleashed** / **released** the prisoner.  
MM They **unleashed** / **released** her worries.
8.  
LL Kathy **devoured** / **consumed** the gourmet meal.  
ML Kathy **devoured** / **consumed** the lecture material.  
MM Kathy **devoured** / **consumed** the child's attention.

9.  
LL The mischievous student **craned / stretched** his neck to see the board.  
ML The mischievous student **craned / stretched** his rubberband for firing.  
MM The mischievous student **craned / stretched** his imagination in class.
10.  
LL They **retreated / withdrew** the troops.  
ML They **retreated / withdrew** the invitation.  
MM They **retreated / withdrew** their welcoming smiles.
11.  
LL They **melted / dissolved** the ice.  
ML They **melted / dissolved** the alliance.  
MM They **melted / dissolved** his confidence.
12.  
LL He **garnished / decorated** the meal.  
ML He **garnished / decorated** the war hero.  
MM He **garnished / decorated** the truth.
13.  
LL She **bridled / confined** the horse.  
ML She **bridled / confined** the oil spill.  
MM She **bridled / confined** her fury.
14.  
LL The official **evicted / ejected** the tenants from the apartment.  
ML The official **evicted / ejected** the cannonball from the cannon.  
MM The official **evicted / ejected** the fears from the crowd.
15.  
LL The woman **sutured / repaired** his leg.  
ML The woman **sutured / repaired** his best suit.  
MM The woman **sutured / repaired** his enthusiasm.
16.  
LL They **parachuted / dropped** the bomb into enemy territory.  
ML They **parachuted / dropped** the candy into the trick-or-treaters' bag.  
MM They **parachuted / dropped** the information into the discussion.

17.  
LL She **shot / delivered** an arrow across the room.  
ML She **shot / delivered** a message across the room.  
MM She **shot / delivered** a glance across the room.
18.  
LL The medic **darned / mended** his socks.  
ML The medic **darned / mended** the cut.  
MM The medic **darned / mended** his marriage.
19.  
LL Jason **piloted / maneuvered** the airplane across the country.  
ML Jason **piloted / maneuvered** his dance partner across the floor.  
MM Jason **piloted / maneuvered** the campaign across the country.
20.  
LL We **amputated / excised** the gangrene toe from his foot.  
ML We **amputated / excised** the frames from the film.  
MM We **amputated / excised** time from our busy schedules for a vacation .
21.  
LL He **buckled / fastened** his new leather belt.  
ML He **buckled / fastened** a bandage around her knee.  
MM He **buckled / fastened** his attention on the performance.
22.  
LL The leaders **enslaved / dominated** the prisoners for personal gain.  
ML The leaders **enslaved / dominated** others' efforts for personal gain.  
MM The leaders **enslaved / dominated** the wind to work for their own benefit.
23.  
LL The children **flooded / inundated** their sandbox with water.  
ML The children **flooded / inundated** their sick classmate with get well cards.  
MM The children **flooded / inundated** their baby-sitter with questions.
24.  
LL The gala activities **taxed / depleted** my revenues.  
ML The gala activities **taxed / depleted** my energy.  
MM The gala activities **taxed / depleted** my caterers.

25.

- LL The man **lured / provoked** the child into the car.
- ML The man **lured / provoked** the speaker into a debate.
- MM The man **lured / provoked** the car into the garage.

26.

- LL The man **trapped / captured** the bear.
- ML The man **trapped / captured** the majority vote.
- MM The man **trapped / captured** her likeness.

27.

- LL The carbon monoxide **suffocated / killed** the suicide victim.
- ML The carbon monoxide **suffocated / killed** the trees.
- MM The carbon monoxide **suffocated / killed** our environment.

Stimuli for Experiment 2: Dual reference in predicative metaphors  
(relevance ratings and priming paradigm)

Prime Type

- M     metaphor  
L     literal

Target Type

- R     relevant to the metaphor ground (MR metaphor-relevant property)  
I     irrelevant to the metaphor ground (MI metaphor-irrelevant property)

Primes and target of each item are listed by whether the selectional restriction violation occurs with the subject noun phrase or the object noun phrase of the metaphor sentence. Note that metaphor items are the sentences from Experiment 1 that were constructed with the specific verb and the noun type that violated both verbs (i.e., the Two violations noun type). Therefore, these metaphors exhibit violations of two levels of selectional restrictions.

Subject noun phrase violations:

1.  
M     The idea **flew** across town.  
L     The bird **flew** across town.  
R     Flying is a fast way to travel  
I     Flying is travelling through the air
2.  
M     Margaret's careful plan **unravelled** during her vacation.  
L     Margaret's hand-knitted sweater **unravelled** during her vacation.  
R     Unravelling is slowly coming apart  
I     Unravelling is having loose strings
3.  
M     As the ocean storm's intensity increased, Patrick's nerves **frayed**.  
L     As the ocean storm's intensity increased, Patrick's ropes **frayed**.  
R     Fraying is straining and tense  
I     Fraying is having uneven edges
4.  
M     Political opinion is **whistling** toward a common center.  
L     The barber-shop quartet is **whistling** toward center stage.  
R     Whistling is moving  
I     Whistling can be off-key



5.  
M Sara's worn down confidence **limped** to new depths.  
L Sara's worn down nanny **limped** back home.  
R Limping is a sign of damage  
I Limping is a sign of sore feet
6.  
M The paint **danced** over the full extent of the canvas.  
L The children **danced** over the full extent of the stage.  
R Dancing is vibrant and active  
I Dancing is movement to music
7.  
M Sound **rained** on every inch of the arena.  
L Droplets **rained** on every inch of the arena.  
R Raining can be loud  
I Raining makes things wet
8.  
M Lisa's verbal assault **stormed** its way through his emotional defenses.  
L The hurricane **stormed** its way through the coastal defenses.  
R Storming is attacking  
I Storming is a weather condition
9.  
M John **hovered** on her every word.  
L The storm clouds **hovered** over the village.  
R Hovering is being attentive  
I Hovering is hanging above things
10.  
M Their despair **crawled** up to a peak.  
L The toddler **crawled** up the steep slope.  
R Crawling is moving slowly  
I Crawling is done on hands and knees
11.  
M His energy was **slumbering** at a most inopportune time.  
L The black bear was **slumbering** on the side of the road.  
R Slumbering is laziness  
I Slumbering is sleeping

12.

- M The bad news **lumbered** towards town.  
L The club bouncer **lumbered** towards town.  
R Lumbering is slowly moving  
I Lumbering is clumsy walking

13.

- M The autumn leaves **tiptoed** along the trail.  
L The little girl **tiptoed** along the trail.  
R Tiptoeing is light movement  
I Tiptoeing is being careful and quiet

14.

- M Mark's subconscious **ate** at his emotional debris.  
L The raccoons **ate** the debris at the fair.  
R Eating is corrosive  
I Eating is nutritious

15.

- M The words **streamed** through her head.  
L The water **streamed** through the forest.  
R Streaming can be rushing and continuous  
I Streaming can irrigate the soil

16.

- M Thoughts of food **pushed** all other thoughts from his mind.  
L The punkers **pushed** other concert goers off the platform.  
R Pushing can displace things  
I Pushing can cause injury

17.

- M Justice **shivered** at the O.J. verdict.  
L The commuters **shivered** in the harsh wind.  
R Shivering is a sign of revulsion  
I Shivering is a sign of cold

18.

- M The moonlight **danced** rhythmically on the shore.  
L The tap dancer **danced** rhythmically on the stage floor.  
R Dancing is repeating patterns  
I Dancing is movement to music

19.  
M The colors **swarmed** on the mural.  
L The bees **swarmed** on the honeycomb.  
R Swarming is blending together  
I Swarming is quickly covering
20.  
M The lease **obeyed** the zoning regulations.  
L The soldiers **obeyed** their commands.  
R Obeying is fulfilling conditions  
I Obeying is following your leader
21.  
M Her courage **inflated** to meet the challenge.  
L The balloons **inflated** into unusual shapes.  
R Inflating is getting bigger  
I Inflating is filling with air
22.  
M Inflation **climbed** to new heights.  
L The hikers **climbed** to the mountain ridge.  
R Climbing is rising  
I Climbing can be adventurous
23.  
M The vegetable garden **howled** for attention.  
L The dog **howled** for attention.  
R Howling gets noticed  
I Howling is noisy
24.  
M Julie's thoughts were **floundering** to fit together in class.  
L The tuna were **floundering** to escape from the fisherman's net.  
R Floundering is ineffectual effort  
I Floundering can be desperate
25.  
M The town vagabond's sanity **wilted** over time.  
L The entire harvest **wilted** over time.  
R Wilting is slow deterioration  
I Wilting is drying out

26.

- M The sunshine **kissed** the bouquet of flowers.
- L The little girl **kissed** the bouquet of flowers.
- R Kissing is gently touching
- I Kissing is done with lips

27.

- M The rumor **infected** the nuclear plant workers.
- L The virus **infected** the nuclear plant workers.
- R Infecting can spread discontent
- I Infecting can spread disease

Object noun phrase violations:

1.  
M The young lover **kidnapped** the moon for the evening.  
L The young man **kidnapped** the child that wandered from the group.  
R Kidnapping is borrowing  
I Kidnapping is a crime
2.  
M The woman **killed** her desires.  
L The woman **killed** the prize winning hog.  
R Killing is suppressing  
I Killing is slaughtering
3.  
M Before it was too late, Brian **holstered** his pain.  
L Before it was too late, Brian **holstered** his weapon.  
R Holstering is controlling  
I Holstering is putting away
4.  
M Jen **filed** her anger.  
L Jen **filed** her official letters.  
R Filing is ignoring things  
I Filing is organizing things
5.  
M Matt **unlocked** her heart.  
L Matt **unlocked** his door.  
R Unlocking is setting free  
I Unlocking requires a key
6.  
M Melissa **uncorked** her thoughts.  
L Melissa **uncorked** the bottle of wine.  
R Incurring is revealing  
I Incurring permits pouring
7.  
M They **unleashed** her worries.  
L They **unleashed** the dogs.  
R Unleashing is losing control  
I Unleashing is releasing

8.  
M Kathy **devoured** the child's attention.  
L Kathy **devoured** the gourmet meal.  
R Devouring is enjoyable  
I Devouring is eating
9.  
M The mischievous student **craned** his imagination in class.  
L The mischievous student **craned** his neck to see the board.  
R Craning is expanding  
I Craning is bending
10.  
M They **retreated** their welcoming smiles.  
L They **retreated** the troops.  
R Retreating is reneging  
I Retreating is giving up ground
11.  
M They **melted** his confidence.  
L They **melted** the ice.  
R Melting can be destructive  
I Melting can produce water
12.  
M He **garnished** the truth.  
L He **garnished** the meal.  
R Garnishing is exaggerating  
I Garnishing is decorating
13.  
M She **bridled** her fury.  
L She **bridled** the horse.  
R Bridling is controlling  
I Bridling requires a halter
14.  
M The official **evicted** the fears from the crowd.  
L The official **evicted** the tenants from the apartment.  
R Evicting is reassuring  
I Evicting is kicking people out

15.  
M The woman **sutured** his enthusiasm.  
L The woman **sutured** his leg.  
R Suturing is repairing  
I Suturing can sting
16.  
M They **parachuted** the information into the discussion.  
L They **parachuted** the bomb into enemy territory.  
R Parachuting is inserting things  
I Parachuting can be dangerous
17.  
M She **shot** a glance across the room.  
L She **shot** an arrow across the room.  
R Shooting is delivering quickly  
I Shooting includes taking aim
18.  
M The medic **darned** his marriage.  
L The medic **darned** his socks.  
R Darning is fixing something  
I Darning uses needles
19.  
M Jason **piloted** the campaign across the country.  
L Jason **piloted** the airplane across the country.  
R Piloting is directing  
I Piloting is flying
20.  
M We **amputated** time from our busy schedules for a vacation.  
L We **amputated** the gangrene toe from his foot.  
R Amputating is removing  
I Amputating is surgery
21.  
M He **buckled** his attention on the performance.  
L He **buckled** his new leather belt.  
R Buckling is focusing  
I Buckling is fastening

22.  
M The leaders **enslaved** the wind to work for their own benefit.  
L The leaders **enslaved** the prisoners for personal gain.  
R Enslaving is using  
I Enslaving is cruel
23.  
M The children **flooded** their baby-sitter with questions.  
L The children **flooded** their sandbox with water.  
R Flooding is overwhelming  
I Flooding is soaking wet
24.  
M The gala activities **taxed** my caterers.  
L The gala activities **taxed** my revenues.  
R Taxing is testing the limits  
I Taxing costs money
25.  
M The man **lured** the car into the garage.  
L The man **lured** the child into the car.  
R Luring is guiding  
I Luring is suspicious
26.  
M The man **trapped** her likeness.  
L The man **trapped** the bear.  
R Trapping describes people  
I Trapping catches wildlife
27.  
M Carbon monoxide **suffocated** our environment.  
L Carbon monoxide **suffocated** the suicide victim.  
R Suffocating is polluting  
I Suffocating is killing



# Appendix B

## Experiment 1

### Comprehensibility Ratings

Analyses with subjects as random factor: break down of 3-way interaction between Verb-type, Noun-type and Noun-phrase.

Repeated one-way ANOVAs of Noun-type with contrasts (df = 1, 59):

Noun1 = No violations (e.g., bird/bottle)

Noun2 = One violation (e.g., boy/gate)

Noun3 = Two violations (e.g., idea/thoughts)

Subject noun phrase (e.g., fly/travel)

Verb = specific (fly)

Noun1 vs. Noun2 = 18.41 p<.001\*

Noun1 vs. Noun3 = 48.03 p<.001\*

Noun2 vs. Noun3 = 23.66 p<.001\*

Verb = general (travel)

Noun1 vs. Noun2 = 2.75 p>.05 ns

Noun1 vs. Noun3 = 39.57 p<.001\*

Noun2 vs. Noun3 = 40.88 p<.001\*

Object noun phrase (e.g., uncorked/opened)

Verb = specific (uncorked)

Noun1 vs. Noun2 = 70.10 p<.001\*

Noun1 vs. Noun3 = 85.59 p<.001\*

Noun2 vs. Noun3 = 5.56 p<.05\*

Verb = general (opened)

Noun1 vs. Noun2 = 1.75 p>.05 ns

Noun1 vs. Noun3 = 66.66 p<.001\*

Noun2 vs. Noun3 = 79.60 p<.001\*

Paired t-tests on Verb-type (specific vs. general):

Noun1 (bird/bottle)

subject noun phrase = 1.44 t>.05 ns

object noun phrase = 1.51 t>.05 ns

Noun2 (boy/gate)

subject noun phrase = 4.47 t<.001\*

object noun phrase = 11.18 t<.001\*

Noun3 (idea/thoughts)

subject noun phrase = .37 t>.05 ns

object noun phrase = 2.89 t<.01\*

### Comprehensibility Ratings (cont.)

Analyses with items as random factor: break down of Verb-type by Noun-phrase and of Verb-type by Noun-type interactions.

Between 2 (Verb) x 2 (Noun-phrase) ANOVAs w/Tukey post-hoc (df = 1, 104):  
Any two groups with a common underscore are not significantly different ( $p < .05$ ).

#### Noun 1 (bird/bottle):

##### Verb-type

Mse=.293      Critical range=2.804     $p > .05$

	General	Specific
Mean	6.355	6.459

##### Noun-phrase

Mse=.293      Critical range=2.804     $p > .05$

	Subject	Object
Mean	6.449	6.365

#### Noun 2 (boy/gate):

##### Verb-type

Mse=.35      Critical range=2.804     $p < .05$

	General	Specific
Mean	6.47	5.848

##### Noun-phrase

Mse=.35      Critical range=2.804     $p < .05$

	Subject	Object
Mean	6.37	5.948

#### Noun 3 (idea/thoughts):

##### Verb-type

Mse=.56      Critical range=2.804     $p > .05$

	General	Specific
Mean	5.77	5.602

##### Noun-phrase

Mse=.56      Critical range=2.804     $p < .05$

	Subject	Object
Mean	5.913	5.459

Comprehensibility Ratings (cont.)

Between 2 (Verb) x 3 (Noun) ANOVAs w/Tukey post-hoc (df = 1, 156):

Any two groups with a common underscore are not significantly different ( $p < .05$ ).

Subject noun phrase:

Verb-type

MSe=.286 Critical range=2.793  $p > .05$

General Specific

Mean 6.287 6.201

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Noun-type

MSe=.286 Critical range=3.347  $p < .05$

Noun1 Noun2 Noun3

Mean 6.449 6.37 5.913

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Object noun phrase:

Verb-type

MSe=.516 Critical range=2.793  $p < .05$

General Specific

Mean 6.12 5.738

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Noun-type

MSe=.286 Critical range=3.347  $p < .05$

Noun1 Noun2 Noun3

Mean 6.365 5.948 5.459

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## Metaphoricity Judgments

Analyses with subjects as random factor: break down of 3-way interaction between Verb-type, Noun-type and Noun-phrase.

### Repeated one-way ANOVAs of Noun-type with contrasts (df = 1, 58):

Noun1 = No violations (e.g., bird/bottle)

Noun2 = One violation (e.g., boy/gate)

Noun3 = Two violations (e.g., idea/thoughts)

#### Subject noun phrase (e.g., fly/travel)

Verb = specific (fly)

Noun1 vs. Noun2 = 570.67 p<.001\*

Noun1 vs. Noun3 = 746.71 p<.001\*

Noun2 vs. Noun3 = 27.57 p<.001\*

Verb = general (travel)

Noun1 vs. Noun2 = .36 p>.1 ns

Noun1 vs. Noun3 = 369.40 p<.001\*

Noun2 vs. Noun3 = 467.67 p<.001\*

#### Object noun phrase (e.g., uncork/open)

Verb = specific (uncork)

Noun1 vs. Noun2 = 483.88 p<.001\*

Noun1 vs. Noun3 = 795.07 p<.001\*

Noun2 vs. Noun3 = 84.33 p<.001\*

Verb = general (open)

Noun1 vs. Noun2 = 28.58 p<.001\*

Noun1 vs. Noun3 = 358.56 p<.001\*

Noun2 vs. Noun3 = 288.80 p<.001\*

### Paired t-tests of Verb-type (specific vs. general):

#### Noun1 (bird/bottle)

Subject noun phrase = 2.72 p<.05\*

Object noun phrase = 1.10 p>.1 ns

#### Noun2 (boy/gate)

Subject noun phrase = 25.66 p<.001\*

Object noun phrase = 17.99 p<.001\*

#### Noun3 (idea/thoughts)

Subject noun phrase = 7.08 p<.001\*

Object noun phrase = 9.53 p<.001\*

# Metaphoricity Judgments (cont.)

Analyses with items as random factor: break down of Verb-type by Noun-type interaction.

Between 2 (Verb) x 2 (Noun-phrase) ANOVAs w/Tukey post-hoc (df = 1, 82):

Any two groups with a common underscore are not significantly different (p<.05).

Noun 1 (bird/bottle):

Verb-type

Mse=.647	Critical range=2.813	p>.05
	General	Specific
Mean	2.256	2.049

Noun-phrase

Mse=.647	Critical range=2.813	p<.05
	Subject	Object
Mean	2.337	1.941

Noun 2 (boy/gate):

Verb-type

Mse=.873	Critical range=2.813	p<.05
	General	Specific
Mean	2.55	5.265

Noun-phrase

Mse=.873	Critical range=2.813	p<.05
	Subject	Object
Mean	4.123	3.66

Noun 3 (idea/thoughts):

Verb-type

Mse=.503	Critical range=2.813	p<.05
	General	Specific
Mean	5.016	5.79

Noun-phrase

Mse=.503	Critical range=2.813	p>.05
	Subject	Object
Mean	5.518	5.271

## Aptness Ratings

Analyses with subjects as random factor: break down of 3-way interaction between Verb-type, Noun-type and Noun-phrase.

Repeated one-way ANOVAs of Noun-type with contrasts (df = 1, 59):

Noun1 = No violations (e.g., bird/bottle)

Noun2 = One violation (e.g., boy/gate)

Noun3 = Two violations (e.g., idea/thoughts)

Subject noun phrase (e.g., fly/travel)

Noun1 vs. Noun2 = .23 p>.1 ns

Noun1 vs. Noun3 = 3.68 p = .058

Noun2 vs. Noun3 = 8.21 p<.05\*

Object noun phrase (e.g., uncorked/opened)

Verb = specific (uncork)

Noun1 vs. Noun2 = 39.34 p<.001\*

Noun1 vs. Noun3 = 20.40 p<.001\*

Noun2 vs. Noun3 = 3.67 p>.05 ns

Verb = general (open)

Noun1 vs. Noun2 = 14.18 p<.001\*

Noun1 vs. Noun3 = 7.57 p<.01\*

Noun2 vs. Noun3 = 29.42 p<.001\*

Paired t-tests on Verb-type (specific vs. general):

Noun1 (bird/bottle)

subject noun phrase = 1.76 t>.05 ns

object noun phrase = 7.25 t<.001\*

Noun2 (boy/gate)

subject noun phrase = .912 t>.05 ns

object noun phrase = 4.66 t<.001\*

Noun3 (idea/thoughts)

subject noun phrase = .25 t>.05 ns

object noun phrase = .91 t>.05 ns

Aptness Ratings (cont.)

Analyses with items as random factor: break down of 3-way interaction between Verb-type, Noun-type, and Noun-phrase.

Between 2 (Verb) x 3 (Noun) ANOVAs w/Scheffe's test (df = 1, 156):

Any two groups with a common underscore are not significantly different ( $p < .05$ ).

Subject noun phrase:

No significant differences, nor interactions, between any Verb-type or Noun-type levels.

Object noun phrase (df = 1, 78):

Verb = specific (uncork)

MSe=1.357	Critical F value=3.113		p<.05
	Noun1	Noun3	Noun2
Mean	5.122	3.967	3.761
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Verb = general (open)

MSe=.894	Critical F value=3.113		p<.05
	Noun2	Noun1	Noun3
Mean	5.059	4.583	4.102
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